Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XL. NEW YORK, SATURDAY, AUGUST 16, 1902. No. 7.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

114 LIBERTY STREET, NEW YORK.

PUBLISHED WEEKLY.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

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ELECTRICAL WORLD AND ENGINEER.

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Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER by 10 A. M. MONDAY of the week of issue. New advertisements can be received up to noon of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

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United States, Canada or Mexico, - - - - - - - - - - - per year, $3.00
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France, - 31 francs
Single Copies, - .10

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Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, AUGUST 16, 1902.

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THE METRIC SYSTEM.

One of the most interesting and important steps taken by the Colonial Conference that has just been sitting in London is the adoption of a resolution in favor of the metric system for all the British colonies. Perhaps too much weight may be attached to this expression of opinion, but the colonial statesmen met strictly for business, and would certainly not approve of such a change or policy unless they knew that it was in harmony with the sentiments of their people, whether in Canada, at the Cape, or away off in Australia and New Zealand. We are inclined ourselves to derive encouragement from this formal utterance, and to believe that in a short time necessary steps will be taken to give it force, wherever the state of the law so requires. The progressiveness of the British colonies is a familiar social phenomenon, and their approval of the metric system will do much to assist in moulding opinion and action in the United Kingdom, as it has already done in other matters. The benefit to international intercourse cannot be overestimated, and we may be sure that the colonial officials did not go on record without adducing weighty arguments of that nature in support of their resolution. We are not aware what process exists for giving force and validity to these verdicts and decisions reached by the statesmen of Greater Britain, but it is safe to infer that practical leaders of colonial politics do not meet merely to pass resolutions. Their function is indeed growing rapidly into one of vast significance and utility, and it was never exerted to more beneficial unifying effect than in helping to create throughout the wide dominion of King Edward a simple, universal system of weights and measures.

IMPORTANCE OF ELECTRICAL DEVELOPMENT.

In our comment last week upon the wholesale adoption of electricity in New York City, to meet every one of the new transportation problems, we remarked that this evidence of the importance of modern electrical development was encouragement to all engaged in the field, being but symptomatic of corresponding work and plans in other cities and in other parts of the world. As we have noted in another discussion of trolley work, the electrical engineer and manager finds himself by sheer growth and evolution of his work launched on enterprises and responsibilities the magnitude of which he is prevented from realizing by the mere activity itself that is thus forced upon him. It was but the other day that they were building cable lines in New York; it was but the other day that electrical tests on the elevated road were abandoned as unpromising; and yet all of a sudden the electrical engineer is aroused to the fact that all old and present work is swept away to make room for him and his methods.

The distance that has thus been traveled in some ten years was admirably and strikingly brought out a few weeks ago by Mr. George H. Gibson before the American Association for the Advancement of Science, and brief note was made in these columns at the time of his paper, which, devoted to the economic influences of the electrical industries of Pittsburg, made a splendid generalization of electrical development as a whole as a measure of civilization. Recurring to his impressive figures, it may be noted that the total electrical power in kilowatts per 1,000,000 people in the whole world, outside of the United States, is 640; in Great Britain, the highest outside of the United States, 7,000; while in the United States it is 26,320. The total capital invested in electrical under-

takings in the world outside of the United States is 45 cents per capita; in Great Britain, the highest outside of the United States, it is $4.25, and in the United States $38.18. The miles of electrically operated railway are, in the whole world, outside of the United States, 4.64 per million people; in Germany, the next highest of foreign countries, 41.8 miles, and in the United States, 276.2 miles. Even more striking is the fact that the new plant of the Manhattan Elevated Railway, of New York City, will have a total power, available for traction, of 40,000 kilowatts, equal to the total electric power available for traction purposes in France. Further, if we take New York City as a unit, the total power now available, or shortly to be available, will approximate that at present found in the Empire of Germany. The five mammoth power houses on Manhattan Island have a total normal rating of some 322,500 hp, and a maximum rating of 478,000 hp. This is enough power to lift the whole population at the rate of 80 feet per minute, or much faster than an athletic man can for any length of time run upstairs. In other words, the work of these five central power plants is more than could be done by all the people on the Island working continuously. In the United States is developed 69 per cent. of all electricity available in the world, 76 per cent. of all that portion available for traction, 76½ per cent. of all the electric railway mileage, and 83½ per cent. of all the trolley cars.

These are, indeed, profoundly impressive and suggestive figures, so far as the lighting and power of this country are concerned, and might even be carried further. If we take into account the consumption annually of electrical apparatus in the United States, and add to it the amounts spent on trolley riding, electric lighting, telegraphy and telephone service, it is soon seen that we are spending more as a nation for electricity than for daily bread. The sum spent on electricity certainly reaches between $7 and $8 per head, in the United States; a figure far surpassing the corresponding expenditure of any other nation.

The Submarine Torpedo-Boat.

We note with pleasure that during the recent French naval manœuvres the electric submarine boats "Gymnote" and "Zede" scored handsomely against three battleships. It looks as if this type of underwater warfare had come to stay. Apparently the French are a bit in the lead in its development. Our own Holland boats seem to be exceedingly well designed and manageable, but they have not yet been tried out so thoroughly as the foreign craft, which, of course, have the material advantage of a much longer period of experimentation. The most serious difficulty with submarine boats seems not now to be the mere question of motive power or mechanism generally, but the far more serious one of finding the object of attack. The French boats, we believe, have observation tubes, which enable them to get at least a transient view of the enemy when still just under the surface, but even with this advantage, steering the proper course must be no easy matter, particularly as attacks must generally be made under cover of darkness. Aside from this the mere presence of such a deadly instrument has a moral effect that can hardly be overestimated. Even the bravest men may well wax nervous in the presence of such a foe that deals a stab in the darkness and slips away unseen.

If submarine boats become fairly common, they will tend to develop new lines of naval tactics; of just what kind it is hard indeed to say, There seems to be at present no definite reply to a submarine attack. One can hardly organize a similar underwater defense, for the foe could only be found by accident, and the present boats at least are somewhat lacking in means of offence against their own kind. One thing is certain, that in future wars a blockade will be vastly harder to maintain than it has ever been before, for the tactics pursued at Santiago, of closing in at night and using searchlights, would be highly dangerous in face of submarine boats, to say nothing of the gun fire of an active and vigilant enemy. If it becomes possible to construct craft with a large radius of action, even when running on the surface, they will be still harder to deal with. Under water, a light and powerful storage battery would add greatly to their terrors by giving increased range and speed; but even in their present state they are dangerous neighbors indeed.

The Perennial Trolley Accident.

We have been having this summer the usual ghastly series of trolley accidents, and without desiring to be unduly censorious we must say that it is time to utter a note of warning. Years of experience have taught that single track systems must be operated with extreme caution if accidents are to be avoided. It is not enough to provide turnouts and then to trust the rest to the sometimes meagre discretion of engineers and conductors. So long as trolley cars were built and operated on the general lines of the old horse cars, there was little danger of serious trouble, for the cars were light, easily checked with hand brakes, and were run at very moderate speeds. If a car were off its schedule and another came around the curve ahead, there was little trouble in bringing both to a stop. But the increasing demands upon trolley service have changed all that, and now the larger electric lines run cars little lighter than ordinary steam passenger coaches, at speeds fully as great as those attempted on the less pretentious class of steam roads. With these severer conditions of service, the measures taken to insure safety have not improved in equal measure, so that we now have many electric lines which are operating in a manner that would be considered unsafe by any competent steam railway man.

The evil is not, we think, at all due to recklessness on the part of electric railway managers, but to lack of full appreciation of the conditions which really exist. Speeds have increased gradually, and cars have slowly grown longer and heavier, and the whole subject has been approached from the street railway side by a process of evolution. Most electric railway managers, even on the large systems, are graduates of tramway service, and their extra-urban systems pass into serious railway work without a conspicuous break. Hence, they are taken to a certain extent unawares. But a line that operates fast and heavy cars on a single track is not relieved of any moral or material responsibilities by the use of electricity as a motive power. A considerable proportion of the long electric lines in this country are ordinary railroads in all save motive power, and they must face the situation squarely, and employ all the available safety devices known in railway practice or face the inevitable consequences.

If the present series of fatalities keeps on, due to careless motormen on single tracks, we shall be treated to some drastic legislation, which will be a real injury to electric traction. This is the time for averting it, for in the very near future it will be too late. When a road attempts high speed with long and heavy cars, it must approach the matter from the true railway standpoint, and take full advantage of all that years of experience in railroading have taught. Power brakes, a fully developed block system, and, more than all, proper methods of train dispatching are needed on every important suburban electric line; and if such precautions are not adopted willingly, they will be forced upon the unwilling with no gentle hand. Something should be done, and done promptly, to relieve the present situation. On progressive lines, ample safety devices have already been installed, and the sooner their example is followed the better for all concerned.

THE DIRECT MEASUREMENT OF REACTIVE POWER.

On page 245 we print an article by Mr. Frankenfield, which may be useful to many students of electrical engineering. When an alternating e. m. f. produces a current in a circuit, then on the assumption of simple or sinusoidal waves, to which the most complicated cases can be virtually reduced, the current will usually be out of step with the e. m. f. The actual current may, however, be analyzed theoetically into two components, one of which is completely in phase with the driving e. m. f., and may be called the working current; while the other component is in quadrature with the driving e. m. f., or completely out of step therewith, and may be called the wattless component, or reactive component. This analysis is a fiction of the imagination, but it represents in a simple ideal fashion the essential facts of the phenomena actually occurring in the circuit.

If we multiply the driving e. m. f. in volts by the working component of current in amperes, we obtain the average rate of doing work, or the average power, in watts, expended in the circuit. The expenditure may be all useful in the ideal case of a motor devoid of electrical, magnetic or frictional resistances; or it may be all useless, as in the case of a circuit composed wholly of resistances. But whether usefully or uselessly expended, the watts of the working current represent irreversible expenditure, in which the power leaves the circuit finally, or beyond recall. It is power delivered by the circuit to its environment; either as heat or as chemical power, or as mechanical power. The central-station manager calls it real power.

If we multiply the driving e. m. f., in volts, by the reactive component, in amperes, we get as the product, in watts, the average rate of doing work upon an elastic medium. The elastic medium may be ether magnetically stressed, as in the air-core of a reactive coil, or it may be ether electrically stressed, as in the air-film of a condenser; but whichever form of energy is involved, magnetic or electric, the watts accompanying the reactive component of current are expended reversibily in the elastic media environing the circuit. In each alternation the power is first poured out of the circuit into the surrounding medium, where it is stored up temporarily, either as electric energy or as magnetic energy, and then at the wane of the alternation the energy pours back from the medium into the circuit.

The reactive power is just as truly power as the real power. It is just as correctly described in watts as the real power. The only difference is that the one is reversible and recoverable, being alternately directed into and out of the circuit, so that its final sum total in either direction is nil; while the other is irreversible or irrecoverable, and represents the average drain of power from the system. From the central-station manager's point of view, the reactive power is "wattless" or imaginary, because it is not directly available for sale. Instead of being pushed through the consumers' meters at so much a joule or kilowatt-hour, it comes back on his hands twice in each cycle. In the "real" watts accompanying the driving component of current, all the power is pushed through the customers' meters, and sold, except the incidental quantity expended as heat, on the journey, either in wires as copper-loss, or in transformer-cores as iron-loss.

To the station manager, the reactive power is worse than unsalable power. It is an obstacle preventing the machinery from taking its paying load, because the reactive component of current fills up the generator or takes up a share of its current capacity, whereby the machine is unable to absorb and deliver its full rated power from the steam engine on the one hand, or to the consumers on the other hand. Mr. Frankenfield shows how to connect a wattmeter with a balanced three-phase circuit so as to reveal and measure the reactive power, as distinguished from the ordinary method of connection, in which the expended or useful power is indicated. There can be no doubt that it is advantageous to be able to put the reactive power in evidence, since what the eye sees the memory apprehends much more fully than when the suggestion is purely inferred. Moreover, it is advantageous to be able to measure every electric quantity that assumes any practical importance.

If alternating-current circuits had cycles many seconds in length instead of many cycles per second; then the reactive power would have to be supplied by the engines rhythmically. That is to say, the engines would have to work harder and supply both the "real" watts and the "wattless" watts during the ascent of each alternation, and then the stored energy would come to the rescue during the descent of the alternation, and the engines would only be called upon to supply the difference between the "real" watts and the "wattless" watts. Such a low frequency is quite beyond existing commercial practice; but at existing frequencies the same condition exists, only the cycles are so rapid that the mechanical inertia of the moving parts obliterates the fluctuations of power delivered to the generators. Consequently the steam engine indicator-cards do not show the "wattless" power.

It is pointed out in the article that power-factor indicators are now in use as switchboard instruments. While this is indisputable, we are inclined to think that the fewer instruments that are placed on switchboards the better. One of the few objections to the three-phase system is the number of switchboard instruments that its use involves. The fewer pieces of apparatus that are permanently connected to a switchboard, and which the attendants have to examine and maintain, the less will be the likelihood of accidental derangement. Of course it is desirable that the engineer should have all the information necessary for a full comprehension of the working of the system, and such information may involve the use of power-factor measurements, frequency-indicators, reactive-power indicators, etc. All such measurements can, however, be made specially and by the occasional direct application of portable instruments to the terminals of the switchboard, thus dispensing with the necessity of extra permanent space, connections and inspection. The ideal central station would have no switches, no switchboard and no indicating instruments. Such a realization is, of course, at present impossible, and we are obliged to use a very considerable number of switches and of instruments. One can only say, the fewer the better.

For a similar reason we cannot favor the suggestion of providing a reactive watthourmeter in addition to the ordinary watthourmeter for furnishing the data for a more equitable system of charging consumers. Imagine the perplexity of the ordinary consumer operating an alternating-current motor, in addition to incandescent lamps, from a three-phase alternating-current distributing system of street mains when he saw two meters on his premises, one of which showed the kilowatt-hours he really used, while the other showed the kilowatt-hours that passed into and out of his motor in rapid succession without his being able to capture and use them; but for which he was called upon to pay a certain percentage. Apart from the difficulty of getting him to understand the situation, there would be the difficulty of persuading him into paying for those "wattless" kilowatt-hours that he did not convert and use mechanically. A better plan, and one in extended use, is to meter the lamps and the motors separately and charge a price per kilowatt-hour for motor consumption higher than that for lamps, in accordance with the added cost of the reactive power involved.

Governmental Conditions for Pacific Cable.

President Roosevelt has made public the conditions under which the Pacific Commercial Cable Company must operate. The memorandum is as follows:

"The President, having fully considered said application, herewith consents that the company may lay, construct, land, maintain and operate telegraphic lines of cables on the Pacific Coast of the United States and the various territorial waters of the United States, to connect the city of San Francisco, Cal.; the city of Honolulu, Island of Chua, Hawaiian Islands, and by the way of the Midway Islands and the Island of Guam, the Island of Luzon, Philippine Islands, and a point on the coast of the Empire of China, not yet determined.

The conditions are summarized thus:

1. That the company has not received any exclusive concession or privilege, and is not combined or associated with any company or concern having such concession or privilege, such as would exclude any other company or concern formed in the United States of America from obtaining the privilege of landing its cable or cables on the coasts of China, or connecting them with other cable lines or inland lines of China.

2. That the company's cable shall touch at no other than American territory on the way from the United States to the Chinese Empire. The line from the Philippines to China shall be constructed by said company and operated independently of all foreign companies.

3. That the rates to be charged for commercial messages shall be reasonable. (The schedule of rates referred to is as follows: To charge not exceeding 50 cents per word for transmission of messages between San Francisco and Honolulu, and to reduce such rate to 35 cents per word within two years after the proposed cable between San Francisco and Honolulu is in operation. To charge not exceeding $1 per word for the transmission of messages between San Francisco and Manila. To charge not exceeding $1 per word for the transmission of messages between San Francisco and China. To be content to accept from the United States Government half rates for the transmission of government messages.)

4. That the government of the United States or any department thereof, its officers, agents and insular or territorial governments upon the route of such cable, shall have priority for their cablegrams or cablegrams to them, over all other business, at such rates as the Postmaster-General shall annually fix.

5. That the United States shall at all times have the right to purchase the cable lines, property and effects of the said company at an appraised value to be ascertained by disinterested persons.

6. That the government of the United States shall have authority to assume full control of the said cable when at war or when war is threatened.

7. That all contracts entered into by the said company with foreign governments for the transmission of messages by the said cable shall be null and void when the United States is engaged in war.

8. That the United States shall have authority to serve at discretion all branches which may be connected with the main cable line aforesaid during war or threatened war.

9. That the operators and employes of said company (above the grade of laborers), after said cable shall have been laid, shall be exclusively American citizens.

10. That the citizens of the United States shall stand on an equal footing as regards the transmission of messages over said company's lines with citizens or subjects of any other country with which said cable may connect.

11. That the company shall agree to maintain an effective speed of transmission over the main cable route from California to Luzon of not less than 25 words per minute.

12. That the cable laid shall be of the best manufacture.

13. That ample repair service for said cable shall be maintained.

14. That the line shall be kept open for daily business and all messages in the order of priority heretofore provided for be transmitted according to the time of receipt.

15. That no liability shall be assumed by the government of the United States by virtue of any control of censorship which it may exercise over said line in the event of war or civil disturbance.

16. By the grant of this permission the United States Government does not insure or indemnify said Commercial Pacific Cable Company against any landing rights claimed to exist in favor of any company or companies in respect to any of the insular possessions of the United States.

17. That the consent hereby granted shall be subject to any future action by Congress or by the President, affirming, revoking or modifying, wholly or in part, the said conditions and terms.

Galileo Ferraris Award.

We have received inquiry lately as to the Galileo Ferraris award, and as others among our readers may like to have information on the subject we give below copy of a notice which has been furnished to us by Mr. John W. Lieb, Jr., of the New York Edison Company, who was a member of the Ferraris Memorial Committee in this country. The notice is signed by T. Villa, president, and A. P. Palestrino, secretary, and is dated at Turin, April, 1902.

The commission for the Galileo Ferraris award, which was instituted in 1898, composed of representatives of the Executive Committee of the Association of the General Italian Exposition, in Turin, 1898, of the Chamber of Commerce and Arts, of the Royal Academy of Sciences and of the Royal Italian Industrial Museum of Turin, has decided to reopen an international competition for the conferring of this premium on the occasion of the inauguration, which will take place in the second half of September next, of the monument to be erected in Turin to this illustrious scientist.

The premium consists of 15,000 lire and interest from 1899 up to the date of the assignment, and will be conferred upon the author of any invention from which results a notable progress in the industrial applications of electricity.

Competitors can present papers, projects and drawings, as well as machines, apparatus or constructions relating to their inventions.

The jury nominated by the association above named will have most ample powers to execute practical experiments with the inventions presented.

Competitors must present their requests and deliver their works, machines, apparatus or anything else connected with their inventions, not later than the 18th day of September, 1902, at the office of the secretary of the association, which office is located at the administrative committee headquarters of the First International Exposition of Modern Decorative Art, 1902, in the palace of the Chamber of Commerce and Arts of Turin, via Ospedale, No. 28.

A Notable Engineering Medal.

It has already been noted in these pages that early in the year representative members of the four national engineering societies organized for the purpose of celebrating suitably the eightieth birthday of John Fritz, the celebrated American ironmaster and inventor. Under discussion the plan developed until it was decided to establish a John Fritz Medal, to be awarded every year "to the originators of the most useful scientific or industrial achievements, in perpetual honor of John Fritz and to the glory of engineering." This is the first combined action of the four great American engineering bodies. In order that the subscribers to the fund should be numerous, it was deceided to permit each one to contribute $10. Enough has now been subscribed to insure the success of the project, but there is still an opportunity for those who wish to be enrolled. Several thousand dollars have been received.

The purpose is that this medal shall be awarded by a perpetual committee of 16, to be appointed or chosen in equal numbers from the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers. Rules for the award of this medal have been prepared. The field is the world. The committee may select any person of any nationality. No award shall be made until after at least one year of consideration, and it must have the affirmative vote of at least three-fourths of the board. The hope and belief is that this medal will be a distinction not second to the Bessemer Gold Medal, awarded by the Iron and Steel Institute of Great Britain.

The public celebration of Mr. Fritz's eightieth birthday and of the foundation of this memorial will be held in New York City, October 31. This celebration will take the form of a dinner at the Waldorf-Astoria, in which the subscribers to the fund will have the first opportunity to participate. Any of our readers who are interested in this matter, and who may wish to be enrolled among the subscribers to the medal fund should write for particulars to John Thomson, treasurer, 253 Broadway, New York City. The present list of subscribers comprises the flower of American engineering talent and distinction.

The Largest Electrical Transmission of Water Power in Massachusetts.

BY ALTON D. ADAMS.

WATER powers are more conspicuous through large numbers than great individual capacity, in Massachusetts. This is particularly true of those water powers that are electrically transmitted, because the greater powers have been utilized by local factories in most instances. A notable exception to this general rule is presented by a water power of which the development for electrical transmission has recently been completed in the towns of Wilbraham and Ludlow. At Red Bridge, between the towns just named, on the Chicopee River, a dam and dike 880 feet long have been built, the level of the river water raised nearly 50 feet, a fall of more than 5,000-hp capacity developed, and an electric generating station erected and equipped for the utilization of this power. From this station a transmission line extends some four and one-half miles to factories, where the energy drives machinery engaged in the manufacture of ropes and twines. The Ludlow Manufacturing Company, Ludlow, Mass., has made this extensive development and transmission of water power for use in its own factories.

The keynote of American success is individual enterprise and initiative seeking its own advantage, whether business is conducted in the personal, partnership or corporate form. Of this fact the corporation just mentioned is a notable example. Here in an obscure town, with a population, in 1900, of 3,536 persons, 90 miles from tide water and dependent on railway transportation, one of the largest manufacturing enterprises of its kind in the United States or the world has been built up. Many thousands of tons of jute and hemp from far away India, Russia, the Philippines and other minor sources are annually transported to this inland, insignificant New England town, and there converted into products that find a world market.

This line of industry requires relatively large amounts of power for the operation of its machinery, and this power is an important item at a point where all coal must come at least 90 miles by rail. The extensive mills of the company, all of the most substantial stone, brick and timber construction, were, therefore, located at falls on the Chicopee River that yield about 2,500 horse-power. This capacity of local water power has long since been outgrown, and steam engines with an aggregate capacity of 2,400 hp were added. But fuel for the steam plant is expensive, and the same sort of business sagacity that has built up these great works cast about for more water power. Finding no such power available, one has been created, and the equipment for its electrical transmission installed.

The discharge of water by the Chicopee River is notable for its volume and constancy, due to its wide drainage area. A little less than three miles up stream from Red Bridge, where the new dam is located, is Three Rivers, so called from the gathering of the waters. At this point the Swift River, from the hills to the north; the Ware River, so called from the ancient weirs where salmon were caught, and the Quaboag River, whose name smacks of the Irish emigrants who settled Palmer, the town in which Three Rivers is located, about the year 1727, unite to form the Chicopee. This river thus secures a drainage area above the new dam of the Ludlow Company that approximates 200 square miles, and contains many small lakes. Two important considerations which influenced the height of dam selected by the Ludlow Company were the amount of power to be developed and the storage of water for dry seasons. Both of these

FIG. 2.—REAR VIEW OF DAM WITH RIVER DOWN TO OLD LEVEL.

requirements were favored by a dam of the greatest practicable height, and it was accordingly decided to raise the level of water behind the dam to a point more than 40 feet above the then banks of the Chicopee River. Some idea of the lake thus created behind the dam may be got from the photograph which gives a view looking down stream from a point above the dam when the gates at its foot are open so that the water stands at its old natural level. To the left of the river may be seen a cleared area which is covered with water up to the tree line when the water is up to the top of the dam. In order to clear the space up stream from the dam for the great lake to be formed there, it was necessary to relocate the tracks of the Athol branch of the Boston and Albany Railroad, which ran along the river bank, also the highway which crosses the river at Red Bridge. The elevation to be given the water made it necessary to give the dam proper across the original bed of the river a length of 300 feet, a dike at one end of the dam, a length of 316 feet, and a dike at the other end, 165 feet. At the shore end of the longer dike comes the canal with a width of 86 feet 2 inches; and 13 feet added for the abutment at the entrance brings the total length of the dam and its side structures up to 880 feet 2 inches. The dam construction is solid masonry faced with cut blocks of granite. At its base are three gates to let out the water from behind the dam when desired. The height of the dam above the bed of the river is more than 50 feet at one end.

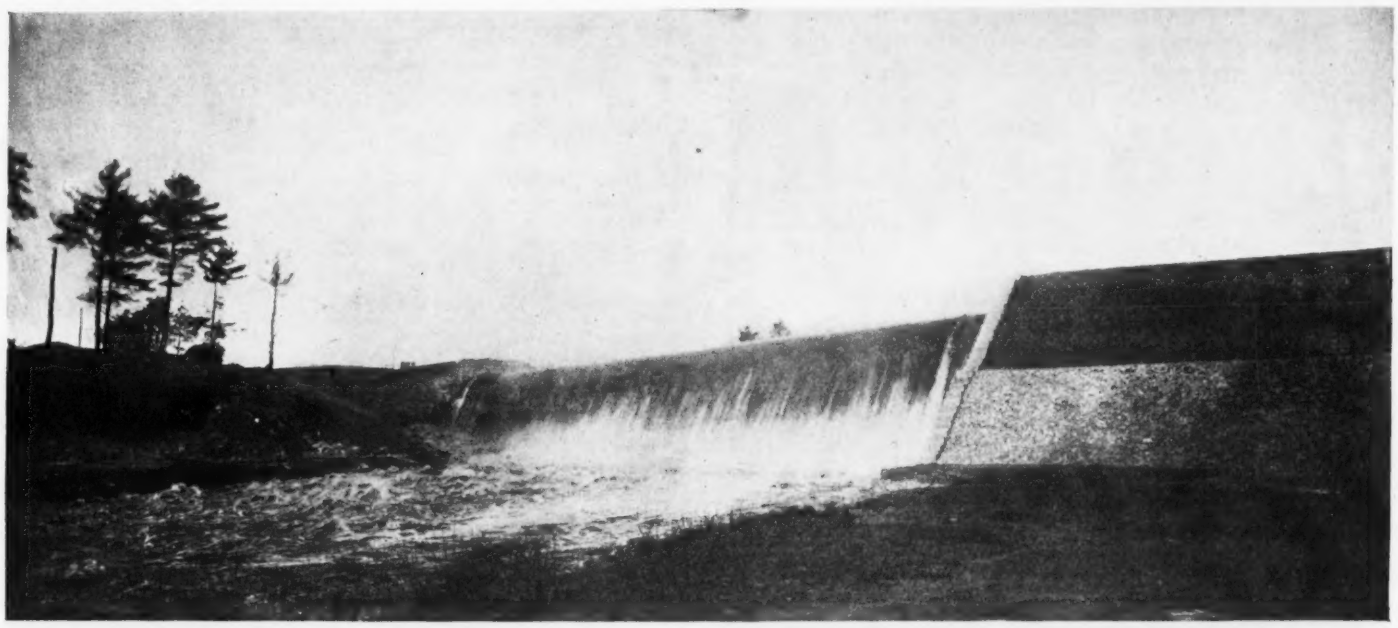


FIG. 1.—GENERAL VIEW OF DAM AT RED BRIDGE.

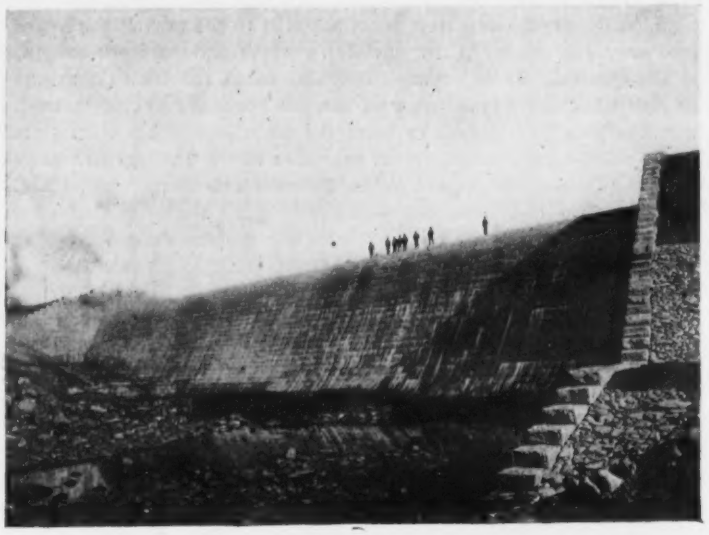


FIG. 3.—DAM AT RED BRIDGE.

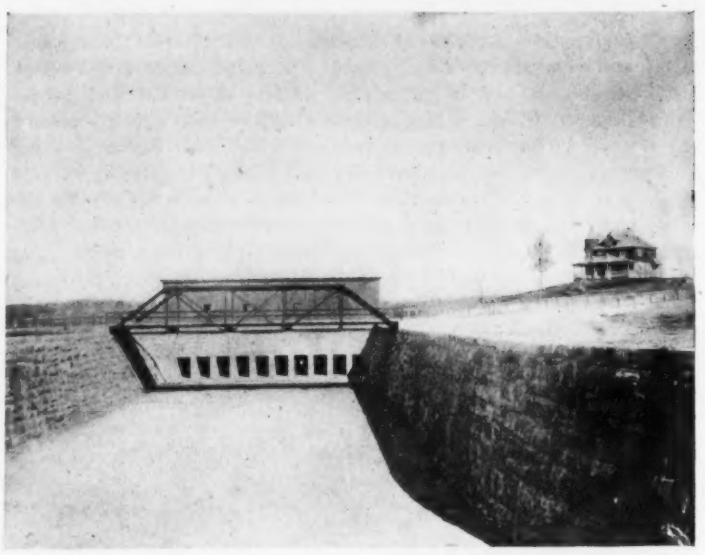


FIG. 4.—CANAL, LOOKING TOWARD ENTRANCE.

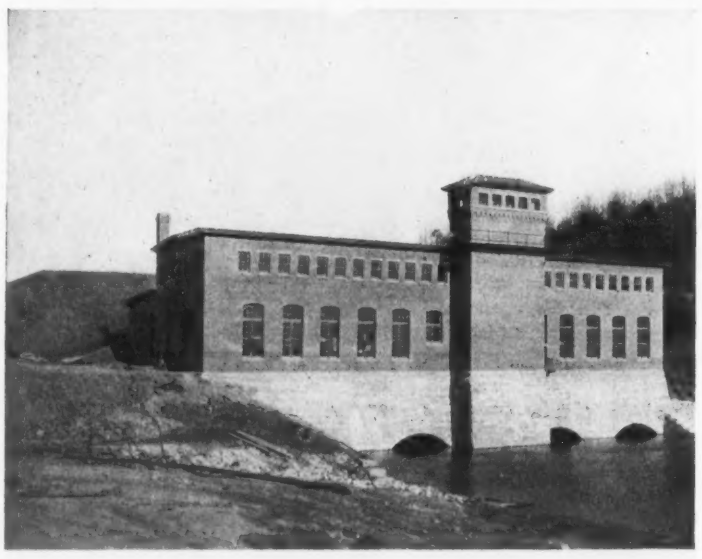


FIG. 5.—POWER-HOUSE AT RED BRIDGE.

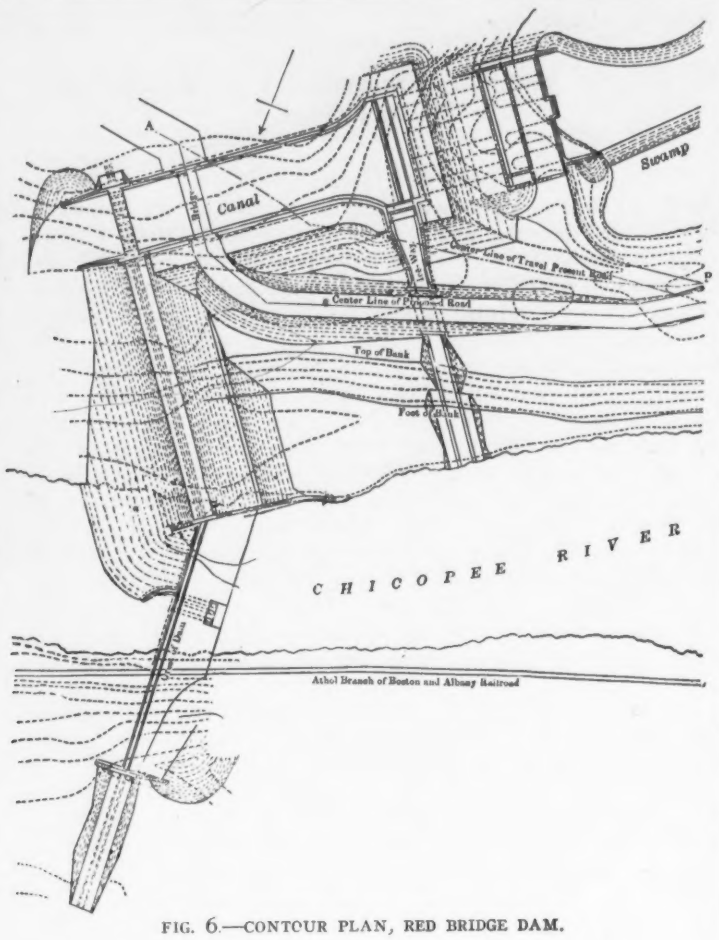


FIG. 6.—CONTOUR PLAN, RED BRIDGE DAM.

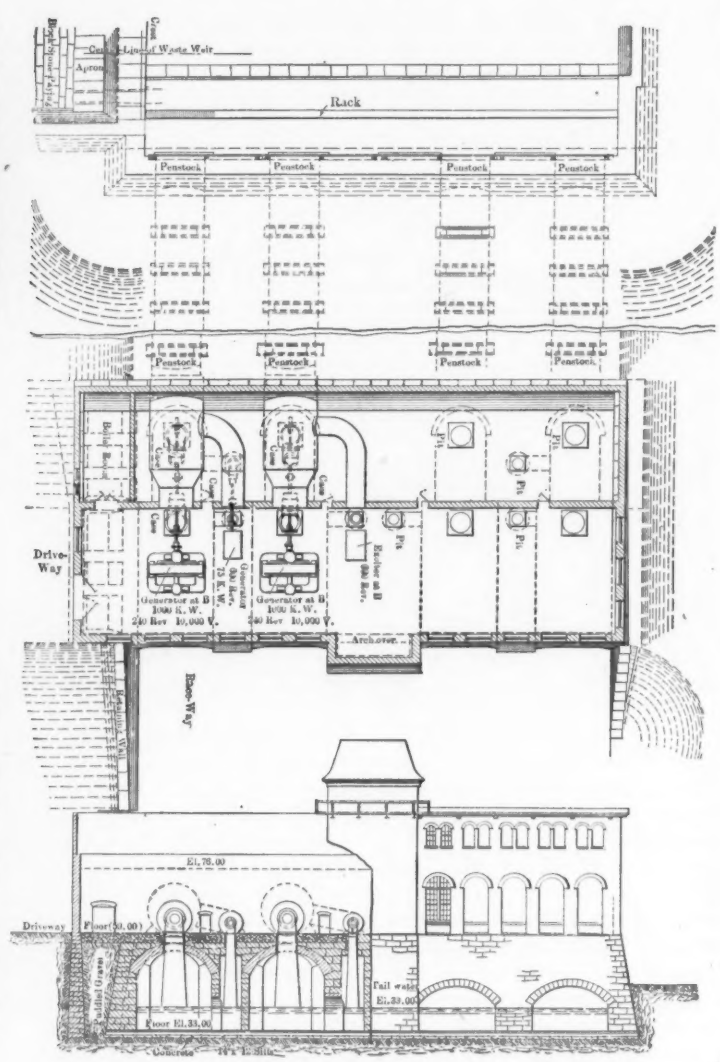


FIG. 7.—PLAN AND ELEVATION, POWER PLANT.

LARGEST ELECTRICAL TRANSMISSION OF WATER POWER IN MASSACHUSETTS.

The great dike at either end of the dam is 9.5 feet higher than the dam crest and about 50 feet above the original banks of the river on which it rests. At its base this dike has a width of about 218 feet, and it is 25 feet wide on top. On its up-stream side, the only one subject to the action of the river water, the dike is paved with rubble and block stone. At the center of the dike is a great core wall of concrete, 65 feet high and 26 feet wide at the base. Beneath the center of this core wall is a row of 8-inch sheet piling. The canal has an inside width of 73 feet and a depth of 13 feet below the top of the dam. Its floor is of concrete, and its sides are of masonry. From entrance to head gates the canal is 340 feet long. These head-gates admit the water to four steel penstocks, each 97 feet 8 inches long and 13 feet inside diameter. Each penstock terminates in a wheel case of 14 feet diameter, which contains a pair of horizontal turbine wheels of sufficient capacity to operate a generator of 1,100 kw, at the speed of 240 r. p. m.

From one side of each of these large wheel cases extends a case of five or six feet diameter, for smaller wheels that are to drive exciters or generators of 200 kw each. Draft tubes extend from the turbine wheels to points below the surface of the tail water, which is 24 feet below the centers of the turbine shafts. The surface of the tail water is 49 feet below the top of the dam, so that the wheels get the pressure incident to this depth of water when the river is just up to the crest of the dam.

The power house, in which are located the water wheels and electric generators, is a substantial brick and stone building with concrete floor throughout, and roof of three-inch plank laid on 10 x 16 timbers over the larger part. On the ground the power house measures 145 feet by 69 feet 10 inches outside, and the interior is all finished as one story. The interior of the power house is divided into two parts by a brick wall two feet thick and running its entire length. One of these parts is 141 by 29 feet inside, contains most of the wheel cases already mentioned, and has a height of 20 feet 6

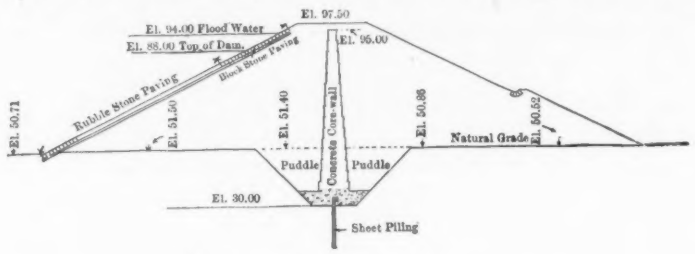


FIG. 8.—CROSS-SECTION OF DIKE.

inches from the concrete floor to the roof at its lowest point. The other part is 141 feet by 33 feet, 4 inches inside, and has a height of 32 feet from floor to roof. This larger and higher portion of the power house contains one end of each wheel case and all the electrical equipment. At an elevation of 21 feet above the floor the wall on each of the two longer sides of the larger room changes in thickness from two feet to one foot, thus forming ledges, each one foot wide, to support the traveling crane that sweeps the entire room. The electrical equipment for this room includes six main generators, two exciters and the switchboard with the usual instruments. Four of the main generators have a capacity of 1,100 kw at 11,500 volts each, and the other two have a capacity of 200 kw at 11,500 volts each. These six generators are direct connected to their respective wheels, and the four larger ones operate at 240 r. p. m., delivering current of 40 periods per second, three-phase. The two smaller generators operate with their wheels at 600 r. p. m.

The two exciters are also direct connected to their respective wheels and operate at 600 r. p. m. All of these generators and exciters were made by the General Electric Company. From this water-power station at Red Bridge, in Wilbraham, to the mills of the Ludlow Company, in Ludlow, a distance of about 4.5 miles, a transmission line of bare aluminum cables is carried on poles with dry glass insulators. The voltage of transmission is 11,500, the same as that of the generators, no step-up transformers being used at the water-power plant. Six cables make up the transmission line, each cable being constructed of seven strands. These six cables form two circuits for the three-phase energy between the generating plant and two sub-stations at the mills of the company. These mills are located in two groups and are known as the upper and lower. Each group has its sub-station, and the two are approximately one-fourth mile apart. At each of these sub-stations is located a bank of three transformers, each transformer having a capacity of 300 kw, and operating with about 11,500 volts at the primary, and 575 volts at the secondary terminals. These transformers are all of the air-cooled type, and made by the General Electric Company. The equipment of transformers is not yet complete, as may be noted by a comparison of the 1,800 kw of transformer capacity with the provision for 4,800-kw capacity in generators at the water power. From the sub-stations three-phase current is distributed to induction motors throughout the mills at the alternating pressure of 575 volts. These motors are all of the three-phase type, built by the General Electric Company, and are in each case belted to short lines of shafting that operate a number of machines each.

Besides the equipment at the new water-power station, the Ludlow Company has one alternating generator of 750 kw, 575 volts and 40 periods per second, and one 250-kw, 500-volt direct-current generator at its mills. These generators are both driven by steam. The 750-kw machine is direct connected to its engine, and operates at 120 r. p. m., and the 250-kw dynamo is belted. Both of these generators supply motors.

The motor equipment at the Ludlow mills is far from complete, but the following numbers of the several capacities each have been installed up to date:

Horse-power.	*Number.*	*Horse-power.*	*Number.*
360	1	20	3
150	4	10	5
100	2	5	5
75	3	3	2
50	2		

The number of these motors is 27 and their combined capacity 773 hp. One 360 and one 50-hp motor operate with direct current; the other motors are all of the three-phase, induction type. As soon as possible the motor equipment will be completed and the steam plant closed down.

Direct Measurement of Wattless Power.

BY BUDD FRANKENFIELD.

IN the ordinary method of measuring power factor in an alternating current circuit, an ammeter, a voltmeter and a wattmeter are properly connected in the circuit and the power factor is taken as the ratio of the wattmeter reading to the volt-amperes in the circuit. This method is a crude one, but until power factor indicators come into general use, it will continue to be the prevailing method. Power factor indicators are now in use as switch-board instruments, but a portable type has not as yet been placed on the market. There is a great demand for just such an instrument. It should be accurate over a wide range of current and pressure, and independent of frequency and wave form; but should take into account any dissimilarity in the pressure and current wave forms in so far as the power factor is affected.

The average student in electrical engineering experiences considerable difficulty in forming a proper conception of the term wattless current; the term wattless power is equally confusing. This may possibly be due, in part, to the fact that both are misnomers—reactive current and reactive power are better expressions—but the terms have been in use so long that it is not likely that a reform can be instituted. To the man who has not learned to think in vectors, the wattless component of power is an evasive sort of spook that bobs up in the most annoying manner. He is not in the habit of measuring it, and its effect is seldom manifested directly, but rather in a roundabout way in conjunction with some other effect.

Wattless power is generally computed by squaring two quantities, taking the difference of these squares, and putting it under the radical; or by rummaging through a set of trignometric tables for the sine of an angle whose cosine is obtained by dividing a certain observation by the product of two other observations. This is not said in disparagement of mathematical analysis, but to bring out what a really complicated train of thought is followed. If it was not for the assistance of graphical methods, it is doubtful if the average student in electrical engineerng would ever get a working knowledge of alternating currents.

It has occurred to the writer that the whole matter can be simplified by the use, in experimental work, of an instrument that will measure the wattless power directly. Education is largely a matter

of sensual experience. What we see, touch or measure directly, is always more easily understood than the results of deductive reasoning. After one has measured the apparent watts in a circuit, the true watts, and the reactive watts, he has all three sides of his vector triangle in the flesh, as it were; and there is then no excuse for difficulty in interpreting the theory.

Professor William Hand Browne, in a paper* before the American Institute of Electrical Engineers, showed that in a single-phase circuit the wattless power, $E\ I\ sin\ \theta$, could be read on a wattmeter if its pressure coil were connected in series with a condenser or an inductive reactance, or to a phasing transformer delivering pressure in quadrature to that of the line. He also showed that, in a balanced two-phase circuit, the wattmeter would indicate the watt-

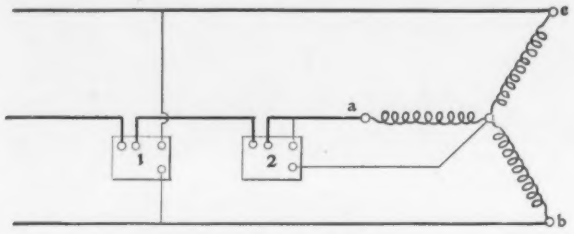


FIG. 1.—DIAGRAM OF CONNECTIONS.

less power if the current coil were connected in one phase, and the pressure coil across the other.

The writer has devised a method for reading wattless power directly in a balanced three-phase circuit.

In Fig. 1, *a, b, c,* represents a three-phase receiver. It is taken as star connected for simplicity. Wattmeter 1 is connected with its current coil in series with line *a,* and with its pressure coil across the circuit *bc.* Wattmeter 2 is connected so as to read the true watts in one-third of the circuit.

Fig. 2 is a vector diagram of the circuit. It shows that the pres-

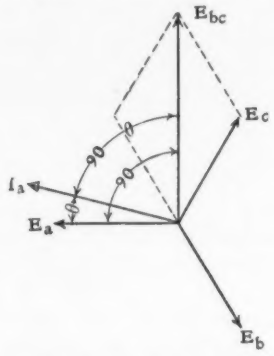


FIG. 2.—VECTOR DIAGRAM.

sure E_{bc} is in quadrature with E_a Counter-clockwise rotation is taken as positive, and I_a represents a lagging current in *a.*

Let E = pressure from any wire to neutral.
I = current in any wire.
θ = angle of lag between E and I.
W_1 = reading of wattmeter 1.
W_2 = reading of wattmeter 2.

Then,

$$W_1 = \sqrt{3}\,E\,I\,cos\,(90^\circ - \theta),$$
$$= \sqrt{3}\,E\,I\,sin\,\theta,$$
$$= \sqrt{3} \times \text{wattless power per phase.}$$

If θ is negative, or an angle of lead,

$$W_1 = \sqrt{3}\,E\,I\,cos\,(90^\circ + \theta),$$
$$= -\sqrt{3}\,E\,I\,sin\,\theta;$$

and the instrument will have to have its pressure coil connections reversed, unless it be of the central zero type.

Aside from giving a visual indication of the amount of wattless power, this method has an advantage over the method of computation, where the phase difference is slight, in that instrumental errors are not so great. With three instruments, the errors are often cumulative, and it is not uncommon to get power factors greater than unity; here the instrument is bound to show reactance if it be at all sensitive; and in addition, its readings are all increased by the factor 1.73.

The method also suggests an application to commercial metering. It is generally conceded that a customer of a central station should be made to pay something for his wattless power, in addition to the charge for the power he consumes. An integrating wattmeter connected so as to rotate at a speed proportional to $E\ I\ sin\ \theta$ will, in conjunction with the regular meter, furnish the data for a more equitable system of charging. Such a sytem can have but one result: better voltage regulation, due to the stimulus that will be given to the manufacture of high power factor motors. A high power factor motor will be placed on the market just as soon as the purchaser finds it to his advantage to pay the necesarily increased price. He will pay that price if by so doing his bills are reduced a sufficient amount.

The above discussion suggests, as an interestng corollary, a method of measuring power factor. Referring to Fig. 1, wattmeter 2 is connected so as to read one-third of the true watts in the circuit. In the case of a mesh connection an artificial star could be used.

$W_2 = E\ I\ cos\ \theta.$

Taking the ratio of the two readings.

$$\frac{W_1}{W_2} = \frac{\sqrt{3}\,E\,I\,sin\,\theta}{E\,I\,cos\,\theta} = \sqrt{3}\,tan\,\theta$$

$$\therefore\ \theta = tan^{-1}\left(\frac{W_1}{\sqrt{3}\,W_2}\right)$$

One wattmeter could of course be used to take both readings by properly connecting its pressure coil through the medium of a double throw switch.

Fig. 3 shows how the readings vary with the phase angle. There

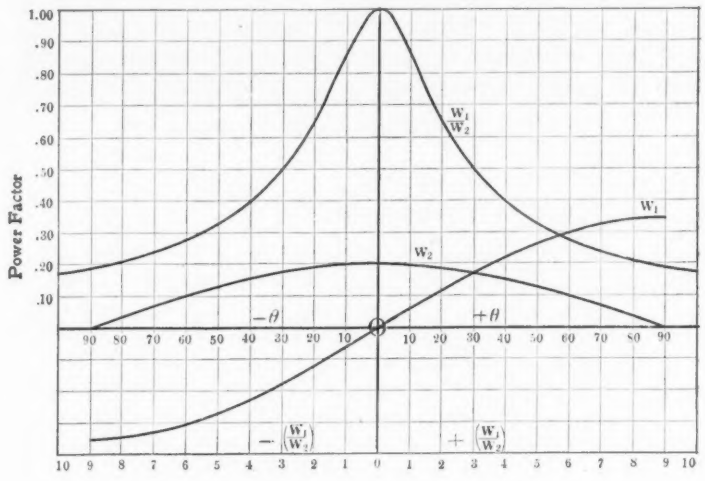


FIG. 3.—CURVES OF POWER FACTOR.

is also a curve of the ratio $\frac{W_1}{W_2}$ plotted against power factor as ordinates. This curve enables one to determine the power factor for a given ratio of readings. The method is analogous to one presented in these columns some time ago.* It has a greater degree of accuracy for power factors between 40 and 60 per cent., and a practical range of accuracy from about 20 to 95 per cent. This makes it suitable for induction motor tests. In this case the current is always lagging, and there will be no reversal of the instruments as in the method referred to. For general use, however, it is inferior.

Wireless Telegraphy in the Navy.

Communication between Washington and Annapolis was established last week by wireless telegraphy under the auspices of the Navy Department. The distance is about 35 miles, which in view of other achievements the officials have decided not to treat as sensational.

* Power Factor Indicators, August 22, 1901.

* Frankenfield, Vol. xxxv, p. 178.

High Tension Circuit-Safeguards.

BY JOSEPH MARTIN ROMAN.

HIGH TENSION is the keynote of successful long-distance transmission, but its utilization has augmented the opportunities for and possibilities of dangers to the transmission system, dangers which are destructive in a far greater ratio than the increase in tension. To effectually safeguard the apparatus and make possible its successful manipulation, the design of controlling and safety appliances has necessarily progressed hand-in-hand with the design of the apparatus itself, and to-day a switchboard controlling and distributing alternating-current output calls into requisition a class of appliances differing materially from what was formerly used.

Fuses and circuit breakers, the latter with the complexity of the magnetic blowout or carbon-break, suffice on continuous current boards to safeguard the system. On the other hand, a consideration of the many electrical transmissions now in operation, of their extent, and the necessity of their maintaining a continuous line, will show how vital is the question of inserting safety devices of proper type and construction at proper points in the line, and when the number and uses of these safety devices is considered it is seen how many annoyances and troubles a well designed protective system can obviate.

The simplest device for rupturing the circuit consists of the fuse, but in alternating work, due to the high voltages used, the tendency is for the voltage to jump the gap formed when the fuse blows, by taking the bridge of heated air as a path, and thus maintain a destructive arc, or else to jump to a point on the other side of the circuit, and thus short circuit the line between the safety devices and the source of energy. To obviate such tendencies, special means must be employed in the design of the fuse-block (or cut-out) and the fuse itself, to effectively maintain the circuit open after the fuse has blown.

These special types vary in size and in construction according to the pressure and capacity of the circuit to be opened, but in all the fuse is well insulated from adjacent parts of the circuit and dependence is placed on the expulsion of the arc from the block into the surrounding air, thus elongating the break, disrupting the circuit and simultaneously causing the heated air that formed the path of the arc, to be diffused throughout the cooler air. The fuse blocks may be mounted on the switchboard panel, preferably at the top or else on separate marble bases, supported by brackets behind the switchboard. This latter position is the most desirable one, provided nothing is sacrificed in accessibility, or immunity from contact with the line wires.

The two ends of the line into which the fuse is to be introduced are soldered into terminals, these two terminals supporting a fuse block. Each terminal consists of a flat piece of cast brass, at one end thickened by a semi-cylindrical addition which receives the wire; at the other end soldered to it is a piece of rolled copper, bent in the form of jaws like switch clips. The length of these jaws is about three-quarters the thickness of the supporting marble panel, which latter has two rectangular holes cut through it 3½ inches apart; into each hole the jaws of one terminal (which is fastened on the back of the panel) extend. Evidently these jaws form the gap which is to be bridged by the fuse. The connection between the fuse and the terminal jaws is made by two chisel-like copper pieces which protrude from the extremities of the fuse block into the gaps between the two pairs of terminal jaws, the block being held in position, by the friction of the contact, on the front of the panel.

For alternating-current circuits of 2500 volts or under a type of fuse holder called simply an expulsion fuse block is made. This consists of a porcelain receptacle, having a rectangle recess hollowed out, into which a piece of lignum vitæ is placed. At each end of the receptacle a copper stud—an extension of the chisel contact piece—comes up through the porcelain, these holding in place a cap, also made of lignum vitæ, provided with a vent hole, but otherwise covering the top of the fuse block, the cap being held firm by insulated thumb-screws on the studs. Joining the copper studs, the fuse is placed between the lignum vitæ pieces and under the vent in the upper one, thus making the arc occur between practically non-combustible materials and causing it to be blown into the outer air by the resulting explosion.

On circuits where the existing potential is above 2500, mechanical means are used to rupture a fuse, when its tensile strength is lowered upon approaching the fusing point by the excessive heating of an overload current. By thus breaking the circuit before the actual melting point is reached, the volume of hot air across the gap, and hence the subsequent arc, is reduced, the tendency to shower out molten metal no longer exists, and a more rapid rupture is possible, thus relieving the generator of the strain of the overload; after the break the ends of the fuse are drawn apart. This mechanical rupture is accomplished by means of a device known as a spring expulsion fuse block, which is inserted in the circuit in the same manner as the ordinary expulsion block, but because of being used on high-tension lines, it is more safeguarded in construction. This device consists of a base and two side pieces of hard wood, varnished and rendered fireproof. Mounted on this base and between the terminals of the circuit is a lignum vitæ block.

Each of the chisel pieces by which the fuse block is connected to the circuit and held in place on the panel, passes through the base and is connected by means of flexible copper straps to a copper piece having mounted on it a stud with nut and washer. This copper piece is shaped much like an inverted U, the legs being supported on a pin and the piece rotating in the plane of the chisel piece. A strong spring on the pin makes the normal position of this copper piece recumbent on the base of the fuse block. When a fuse is in place, it rests on the lignum vitæ block, and is of such length that it holds these terminals in an upright position. A fuse of the form shown is

FIG. I.—HIGH-TENSION FUSE.

strong enough to prevent the tendency of the terminals springing back on the base; but when the tensile strength is lowered by excessive heating, the fuse is finally ruptured and the circuit broken. A cap of lignum vitæ, with a vent, is placed over the fuse, and hard fiber strips at the end of the block entirely enclose the live portions of the device. The side pieces protrude for two inches or more beyond the enclosing strips, and thus form barriers effectually preventing the possibility of arcing over when the break occurs.

On circuits above 5000 volts the connections of this block are insulated from the panel by moulded rubber tubes, which also hold the block and the circuit connections behind the panel, several inches from the marble surface. These blocks are designed to protect circuits with line voltages up to 20,000, and of current capacity up to 100 amperes. The blocks for high-tension service are always mounted on marble slabs, distinct from the switchboard panels, and as an additional precaution against arcing across the line, marble barriers are placed between the blocks.

For each panel mounting these fuse blocks, an extra one with fuse in place is always kept in readiness. When a fuse blows, the operation of replacing consists simply in pulling out the block from its contacts, and mounting the extra one in its place, thus leaving nothing to be desired in simplicity of handling.

On circuits of high tension or carrying large amounts of power, however, the use of fuses is no longer desirable or possible, and a method of automatically breaking the circuit becomes imperative.

The type of circuit breakers used on alternating-current lines differs radically from its prototype on direct-current circuits. Unlike the latter, it is not, except in large installations, used in conjunction with a main switch; but is itself the main switch usually operated by hand, but so constructed that it may be automatically tripped and thus open the *circuit*.

Switches for alternating circuits are of two kinds, those with a quick-break contrivance, which open the circuit in the atmosphere and called "air break"; and those contained in a closed and almost air-tight vessel, and open the circuit beneath the surface of a specially prepared oil—the latter being known as "oil-break" switches.

Air-break switches are used on low-tension circuits, not exceeding 2500 volts, beyond this limit oil switches being built to operate safely on tensions up to 40,000 are now demanded by standard practice. For circuits of higher tension than this (a few of which are in operation), air break switches are again designed. These latter are of special and involved construction, and used in connection with a fuse, which is surrounded by an incombustible compound. But it is the oil-break switch which is found practicable for the range of line tensions in use at the present time, and in conjunction with an automatic tripping device becomes an automatic circuit breaker.

Oil switches are made in several styles, for various voltages and capacities, being single, double and triple-pole and single or double-throw. They range from the switch designed for 100 amperes on a

2500-volt circuit up to 40,000 volts and 100 amperes. The largest current capacity is for 800 amperes at 12,000 volts, this being the capacity of the type now designed for the Niagara and Manhattan Railway equipments.

Usually switches of this type are operated directly from a handle on the front of the panel by means of a system of levers. In the very largest power installations, however, the operation is effected by some electrical or pneumatic auxiliary. This type has been described at length.[1] Since the great bulk of oil switches are intended to be under ordinary circumstances hand operated, the following remarks regarding location apply especially to them.

Oil switches intended for low-voltage circuits are often mounted directly on the back of the panel, with the operating handle—connected by a single lever—on the front. This position is not the most approved practice, mainly because the oil will creep over the iron parts of the switch to the marble panel and permeating it will disfigure the front, despite any means to prevent its occurrence; though all panels controlling oil switches, whether the switch be located on or contiguous to the panel, have several coats of French varnish applied on the back, and often are polished on the back and then coated with varnish to insure freedom from disfigurement.

It is the usual practice to mount oil switches operated on circuits of low voltage on an iron framework behind the switchboard, but when for above 2500 volts they are placed in cells, built of brick with tiled floors and soapstone tops and barriers. There should be no metal of any kind extending through the cell, hence connection between the operating levers and the levers on the switch is made by a stout piece of hardwood, such as hickory, dried and coated with an insulating varnish. This wood is given a test of twice the normal voltage at which the switch works, the potential being applied between contacts at its extremities, to be certain that it will offer no path for leakage.

The mechanism for operating these switches is so devised that the

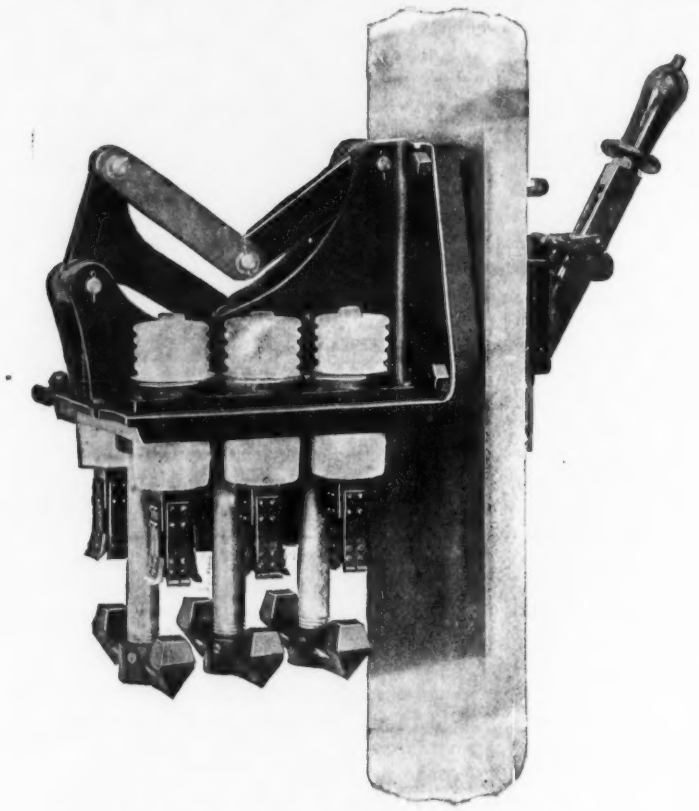


FIG. 2.—OIL-BREAK SWITCH AND CIRCUIT-BREAKER.

switch itself may be placed as safety and convenience dictate, on the floor above or below the switchboard, or on either side of the controlling panel. The mechanism may control one, two or three switches simultaneously, the latter two in the case of polyphase circuits; and it is often preferable, especially on high-tension circuits, to use three single-pole switches, placed in separate cells, in place of one triple-pole switch.

The oil in which the break takes place is contained in a sheet iron case, lined with three layers of alum wood treated to insure good insulating qualities. The case is divided, when intended for double or triple-pole switches, into compartments by partitions built up of three layers of this wood, the grain of the middle layer being at right angle to the outer ones, thus forming effective barriers between the switch contacts.

Small oil switches, usually single-throw intended for low voltage circuit, are arranged with pivoted arms, which are moved upward until their extremities make contact with stationary pieces precisely as the method of making contact in the railway controller.

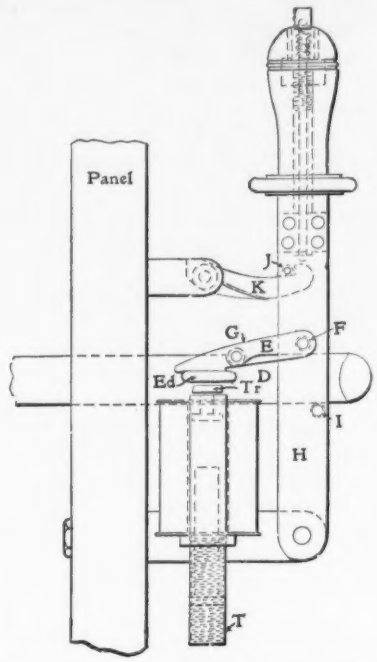


FIG. 3.—DETAIL OF CIRCUIT-BREAKER.

Another type, which is much used where only hand control is desired, is made for single or double-throw, and double or triple-pole breaks, and depends for its operation on a cylindrical piece of wood, turned about its axis by the lever arrangement. This wooden piece has U-shaped pieces of copper fastened to it, which bridge the gaps between the ends of the circuit arranged side by side, but separated by wooden barriers.

Neither of these types of oil switches is to any extent used as an automatic circuit breaker, since for this purpose they are both surpassed in simplicity, surety and promptness of action by the type of which a description follows.

As shown in Fig. 2, the contacts of the moving parts of the switch are wedges, which enter the fixed contacts of the switch, springing them apart, the resultant pressure making a most satisfactory contact surface.

The connecting parts of the switch are made of cast copper, these being supported by stout, well-seasoned hickory rods from a cast iron piece, which is in turn supported by a bell crank. This moving portion is quite heavy, and its weight, in addition to the flexure of the sprung copper contacts, tends to open the switch.

The lever handle is made up of two steel links pinned together at the top and supporting the vulcanized rubber portion which is grasped by the operator. Two pieces, *E, E* (Fig. 3), are connected together by two pins, *F* and *G;* one of these, *F*, pivots the pieces to the links of the handle, and the other, *G*, rests in a notch, as seen in the link, *D*, of the operating mechanism.

The link *D* is supported at one end by the bell crank, and simply rests on the pin *I* in the links of the handle. When the switch is to be closed the pin *G* catches in the notch in the link *D*, and transmits the motion of the handle to the mechanism, closing the switch. As stated, the weight of the moving parts and flexure of the sprung contacts now tend to push the link *D* and handle outward, but this is prevented by the spring catch *K*, which grips another pin *J* in the levers of the handle, thus securely holding the handle and keeping the switch closed.

Evidently then the moving portion of the switch cannot now drop out of contact as long as the linkage system is rigid, but by disengaging one of the links from its adjacent member, the opening can be effected. This is automatically accomplished by a solenoid attract-

[1] ELECTRICAL WORLD AND ENGINEER, Vol. XXXVIII., No. 10; Vol. XXXV., No. 15.

ing an iron plunger which acts as a hammer against the trigger *Tr*. Each of the pieces *E* ends in a projection, or ear, *Ea*, which, when the switch is closed, rests directly over the trigger of the contiguous solenoid. The two solenoids are energized indirectly by series transformers placed in two of the legs of a three-phase system, or one in each circuit of a four-wire, two-phase system. The projecting tubes *T* contain iron plungers, the vertical position of which may be so adjusted that they are pulled up by the solenoids when the exciting current reaches some fixed value.

The operation of this breaker is very simple. An overload by over-exciting the current transformer closes an auxiliary circuit, which closes the energizing circuit. The solenoid pulls up the plunger, which latter raises the trigger *Tr*, knocking the pieces *E* and the pin *G* upwards. The link *D* no longer under the restraint of the spring catch *K*, moves outward as the moving portion of the switch falls. Meanwhile, the handle *H* remains upright, and the link *D* protruding abnormally, indicates to the attendant that the switch has opened and that there has been trouble on the line.

This is the arrangement used when the oil circuit breaker is fastened directly to the panel. When, however, it is placed in a cell at some distance from the switchboard, the arrangement of operating mechanism becomes more intricate and involves more moving parts. This position of the switch makes it impracticable to place the tripping device on the switchboard, since the opening would involve the moving of a long system of cranks, the friction of which on their supports would prevent a rapid break.

In Fig. 4 is shown a switch mounted in a soapstone cell, situated behind and to one side of the controlling panel. Fig. 5 shows in

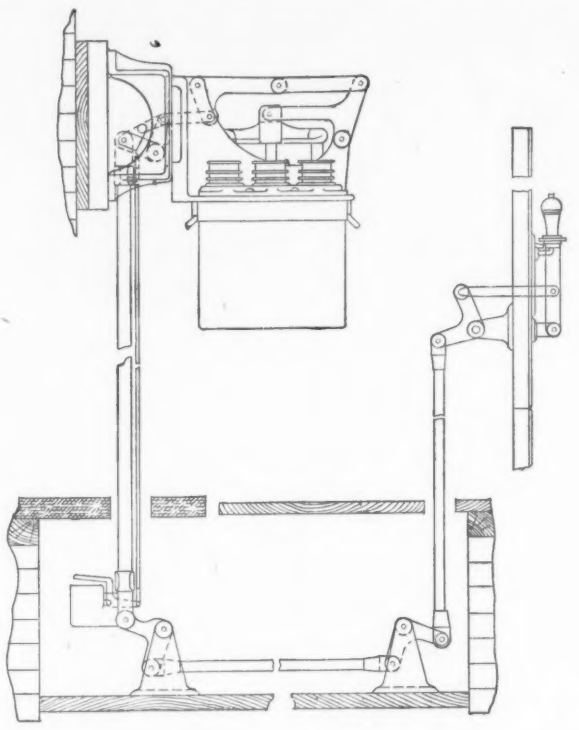


FIG. 4.—OIL CIRCUIT-BREAKER.

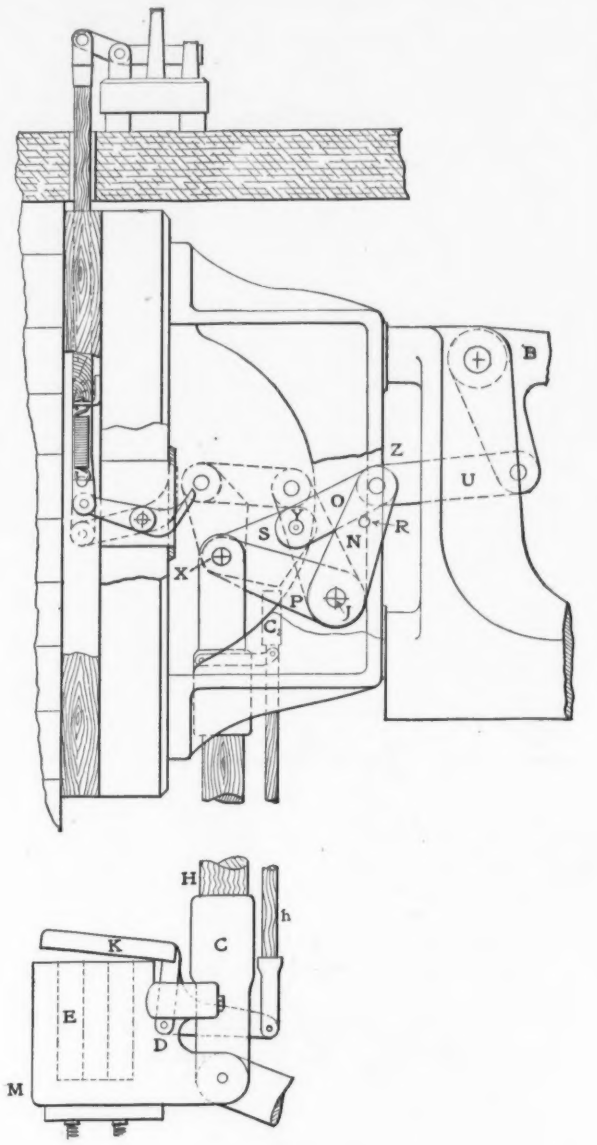


FIG. 5.—DETAIL OF TRIPPING MECHANISM.

detail the arrangement of links directly connected to the switch, with auxiliary signal switch.

The iron pot *M* is rigidly attached to the piece *C*, which clamps the wood rod *H*, the whole being supported on the bell crank of the mechanism. This pot has an iron core, about which a solenoid *E* is wound, the leads coming out at the bottom. The cover *K* of the pot is pivoted at *D*, and supports a clamp for a second and lighter wooden rod *h*. This rod is so supported that its motion is always parallel to *H*, and, moreover, its upper clamp *C*—3 is made longer than necessary and thus heavier, increasing the force of a blow which it can give. By comparing the two figures, it is evident that the position of the links is such that the switch is closed.

The link *U* is attached to the bell crank *B*, of the switch, and the four links *N*, *O*, *P* and *S*, fixed at *J*, take the place of the bell crank of the ordinary non-automatic tripping mechanism. The pin *R* in the link *N* prevents this combination from collapsing when the switch is being closed. In this position the points *X*, *Y*, *Z* of the links are in line, and the tendency of the switch to open is transmitted through links, rods and cranks, and is restrained by the spring catch on the handle, as in the previous case.

When an overload occurs on the line, the solenoid in *M* is energized, and to decrease the reluctance of the magnetic circuit, claps down the cover *K*, which raising the rod *h* causes the piece *C*—3 to strike the triangular link *S*; the sharp blow throws this piece upward, which mars the rigidity of the crank formation, allowing the switch to open, the link *U* moving forward as *N* revolves about the fixed point *J*.

Since no movement of the link or handle has taken place, there is no indication on the front of the board as to the position of the switch, although the instruments on the line would show the condition of load. That the attendant may have instant indication when the breaker opens, a small indicating switch is so connected with the levers of the tripping mechanism, that their opening closes an auxiliary circuit, which causes the illumination of red signal lamps on the front of the board.

The solenoids used in connection with the foregoing circuit breakers are in all cases where possible, energized by direct current, whereas their operation is dependent upon the overload in the alternating line. It becomes necessary, then, to use an intermediary device which actuated by alternating current proportioned to that in the line, shall close a direct-curent circuit in series with the tripping magnet. This device, because of its analogy to similar devices in telegraphy is called a relay. The current transformers operating these relays have their primaries connected in series with the line to be protected, and since their secondaries are grounded, all danger of shock from the relays operated on high-tension lines is removed; also on low-tension lines, the transformer makes unnecessary the use of heavy leads to excite the relay solenoids.

Two relays are required on a three-phase line, having their solen-

oids excited from two of the legs; and on a two-phase system from each of the separate circuits. The use of relays is especially advantageous, since they respond to conditions other than the ordinary overloads, and open the circuit automatically when the desired conditions are attained. Three notable types are in use at the present time, namely, overload relays, overload time relays and reverse current relays.

THE OVERLOAD RELAY.

The overload relay shown in Fig. 7 opens the line on overload or short circuits just as would a fuse or circuit breaker. It consists

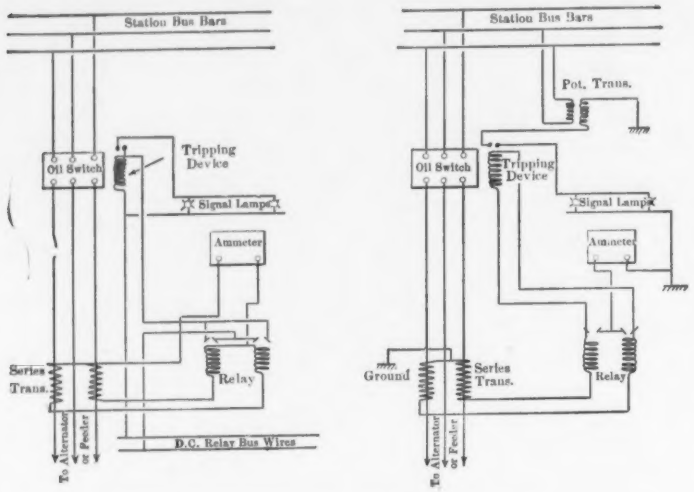


FIG. 6.—CONNECTIONS OF OVERLOAD RELAY.

of a solenoid surrounding an iron plunger which may be drawn up vertically, causing a second piece placed above it to impinge on contacts and close a local circuit to the tripping magnets on the oil-circuit breaker. The plunger of this relay is supported by a disk in the tube extending beneath the solenoid, which disk may be moved vertically, and hence adjust the position of the plunger for different current strengths. In many recent installations, especially in the small substations of long railway lines now being installed, it is desirable to

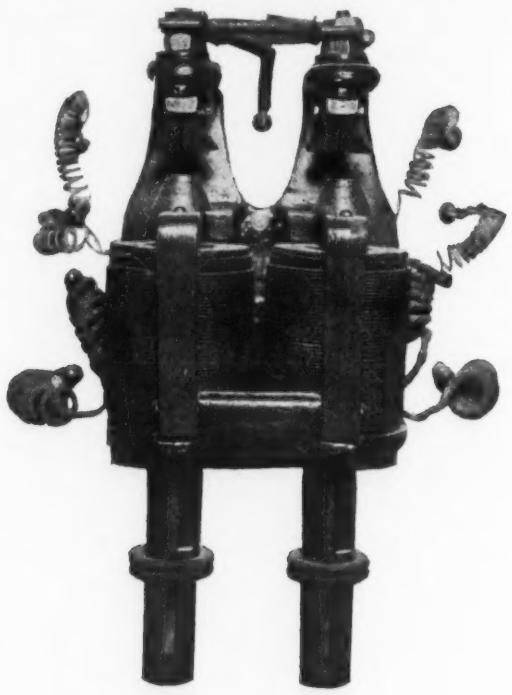


FIG. 7.—OVERLOAD RELAY.

do away with the direct current and to use the same transformer which operates the relay to trip the breaker. In this case practically the same type of relay is used. The tripping device on the oil switch is connected in series with the relays and secondary of the current transformer. A connection is made which, under normal conditions, short circuits the tripping device. The plunger of the solenoid in this case opens this short circuiting connection when drawn up, and allows the tripping magnet to be actuated.. A diagram of the connection of each case is shown in Fig. 6, including the wiring of the signal lamps.

THE OVERLOAD TIME RELAY.

This type of apparatus is designed to operate the circuit-breaking device if the overload continues for a predetermined and adjustable length of time, remaining unaffected if it continues for less than this time. This relay meets two conditions that arise in practice.

First, it takes care of temporary overloads. In the many cases of crosses or short circuits on lines which burn themselves clear, it is undesirable to open the circuit unless such effect should continue. When starting up induction motors or synchronous apparatus slightly out of synchronism, a heavy rush of current occurs, which subsides as the machine comes up to speed.

Second, it tends to localize the effect of the overload, causing its removal by the opening of the proper device in the network nearest such overload. An alternating circuit protected by time relays may feed a rotary having ordinary breakers on its direct-current side. An overload on this side of the line will immediately blow the direct-current breaker, but will not affect the alternating-current side, thus leaving the rotary running light and obviating the inconvenience of starting up each time an overload occurs. An alternating-current station distributing its energy through an extended system of feeders and sub-feeders may best be protected by taking advantage of the time adjustment feature of these relays. In the main feeders, relays designed to open the circuit in five seconds may be placed; in the sub-feeders may be placed relays operating in three seconds, and the local circuits may be protected by the ordinary instantaneous overload relays. Thus an overload or short circuit in a local circuit would open the circuit immediately; in a sub-feeder would have to continue for a certain length of time, and the main line would only be opened if a short circuit of some duration occurred between the generating and feeding points. The advantages attendant on the use of this apparatus are obvious, mainly precluding the possibility of a short circuit in a feeder opening all the other branches, thereby occasioning an unnecessary cutting off of all light and power.

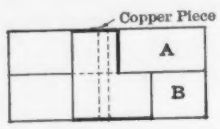


FIG. 9.—A DETAIL OF TIME-LIMIT OVERLOAD RELAY.

TIME-LIMIT RELAY.

The time limit relay (Fig. 8) is operated by clockwork. On one of the shafts of a gearing having a slow motion two wooden disks (1 inch diameter) are mounted side by side. A piece of copper is placed on their peripheries, as shown in Fig. 9. Two contact pieces of spring

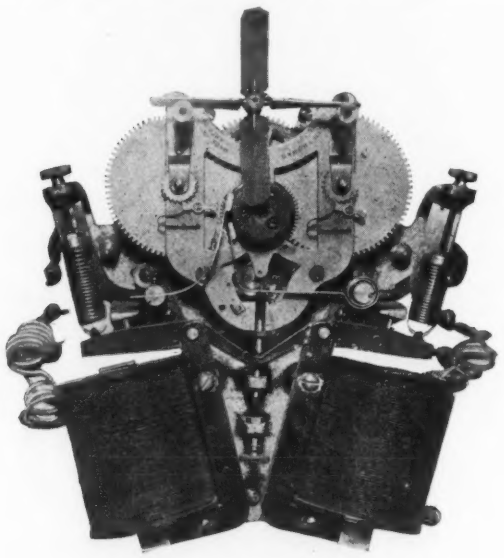


FIG. 8.—TIME-LIMIT OVERLOAD RELAY.

brass are so arranged that one always presses against the disk *B*, but the other is so held that normally it is just out of contact with the surface of *A*. On the same shaft with the wooden disks is mounted a circular piece of brass having a notch in its periphery, and in this notch a ratchet catches, which prevents the motion of the clockwork.

On another shaft of the mechanism having a high rotative speed four aluminum vanes are mounted at right angles to one another.

The variable time interval is controlled by these damping vanes, since varying the angle between their planes and the plane of revolution causes a variation in speed of the clockwork, and hence changes the time per revolution of the wooden disks; the variation of time is from 3 to 10 seconds. When the mechanism is inoperative, one contact piece rests on the extension of the copper piece on *B*, the other rests over, but not touching, the wooden periphery of *A*, and so placed that when the disk rotates the copper strip turns away from it.

These contact points are in the auxiliary circuit taken from a low-voltage direct-current line in the station, having the tripping magnets of the oil switch in series, and thus forming the break in this auxiliary line.

Two small cylindrical iron pieces about one inch long, joined together and supported by a spring allowing vertical motion, are so mounted that one is directly beneath a lever attached to the ratchet previously mentioned and the other beneath the spring contact over the disk *A*. The two solenoids are excited by current transformers, and the two small pieces are pushed upwards; one releases the ratchet and the iron pieces which are attracted by their cores are arranged as levers, each beneath one of the small iron pieces referred to.

When a short circuit occurs, one or both, of the coils are energized, and allows the movement of the clockwork, the other presses the contact against the disk *A*. During the continuance of the short circuit, these magnets continue energized and hold the parts in the position just noted. If this continues for the interval that it takes the disks to revolve, a position occurs when both contacts touch the copper strips on the periphery of the disks and close the auxiliary circuit; if, however, the trouble is removed, the iron pieces are pulled back into their normal position by springs, removing the contact pieces from the surface of disks *A*, and allow the ratchet to stop the mechanism when one revolution has been made without tripping the breakers. The solenoids close their magnetic circuit against the adjustable tension of a spring, and it is by these springs that calibration is effected. The time limit relay is placed in a glass case to protect the contacts from dirt or injury, and is mounted on the panel which controls the outgoing line.

REVERSE CURRENT RELAY.

In consequence of the duplication of transmission lines, this type of apparatus finds a field where maintenance of the continuity of power service is imperative. To insure the connection between main and sub-station on all high-tension circuits, these are tied together by two parallel transmission lines, being usually protected by circuit breaking devices at their outgoing and incoming ends. The main station has two sets of bus-bars, and from each set one line leaves the station; but it is often the case that these lines are connected to one set of busses at the sub-station. A short circuit or excessive overload on either line will have the same effect as a short circuit on both lines through the sub-station bus-bars, and the result will be the opening of all the breakers if overload types of relay are used, thus completely severing the power service to the sub-station.

The reverse current relay meets an emergency of this nature, opening the circuit when current flows through it in the reverse direction, but remaining uneffected by normal flow. In a transmission line overload breakers are put in the line at the outgoing main station end, the incoming sub-station end being protected by relays of the reverse type. An overload on either line will open its overload breaker at the main station end, and the current backing up into this line from the sub-station will operate the reverse relay there, thus completely opening this line at both its ends, but leaving the other intact.

Reverse relays also find a use to open the circuit or give visual indications in other cases. For instance, when several generators are running in parallel on the station bus-bars, if one should for any reason cease to generate and tend to run from the bars as a motor, this action would not be indicated by the instruments; but a reverse relay might open the main switch of this generator or else indicate it to the attendants by means of signal lamps or alarm bells.

The device is also used in the same way on rotary circuits when the rotaries are running in parallel with other apparatus, or charging storage batteries. If the alternating source of power should cease, the rotaries would then run inverted, occasioning liability to serious strains, if not trouble, when the power again comes on. This relay consists simply of a direct-current motor of small size, usually about ⅛ hp. Its fields are energized from a current transformer in series with the line, and its armature circuit takes current from a potential transformer across the line.

When current flows through the lines to be protected in the proper direction, the motor armature tends to turn in a certain direction, clockwise, let us say, but is really blocked to prevent such turning. On the frame of this motor are mounted two contacts arranged thus / \ which are the ends of the circuit energizing the tripping device on the oil switch in the line to be protected. The motor shaft has mounted on it a V-shaped carbon piece which fits in these contacts. Normally, the motor tends to turn away from them, but when the current in the line reverses, the field current of the motor is reversed in consequence, the direction of flow in the armature remaining unchanged. The motor then turns in the counter direction through about one-eighth of a revolution. The V-shaped piece impinges on the contacts, closes the magnetizing circuit, and thereby instantly trips the breaker, or else lights up the signal lamps, as the case may be. The circuit connections of Fig. 10, including the switch for automatic and hand control, show the arrangement of apparatus.

Another arrangement of reverse current relay consists of a device like the ordinary overload type. Each solenoid has two coils, wound differentially, one winding being energized from a potential transformer and the other from a series transformer. Normally the attractive force of the solenoid on the plunger is *nil,* but if a reversal of current in the line occurs, the series excitation decreases, allowing the winding from the potential transformer to close the auxiliary circuit and open the line.

A new device recently developed is a reverse-current, time-element relay combining the functions of all three of the previous noted devices, and designed to open the circuit, as the name indicates, when a reverse current of a certain magnitude continues for a predetermined time. This goes a step further than the time element relay. Using the same piece of apparatus the solenoids are differentially wound, one winding being taken from a potential transformer across the line, the other winding from a series transformer. Normally, the attractive force of the solenoid is *nil,* but if the reversal attains a certain value for which the device is calibrated, the clock mechanism

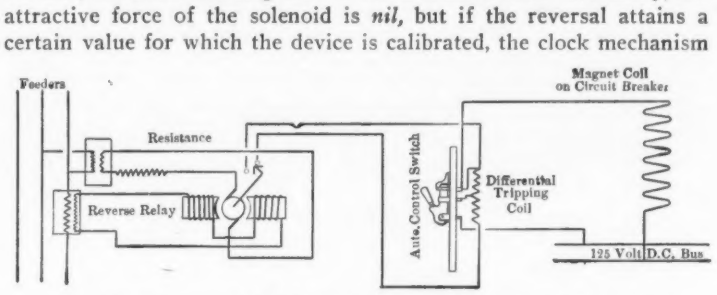


FIG. 10.—CIRCUIT CONNECTIONS OF REVERSE-CURRENT RELAY.

is operated, and if the reversal continues at this value for the predetermined time, the circuit is broken.

It has been repeatedly pointed out that the sudden opening of a high-tension circuit, especially when a short circuit exists on the line, is an operation fraught with some consequence, due to an attendant resonant rise of potential and maintenance of the arc.

The results of recent experiments by Steinmetz, Rice and others at Kalamazoo, where high-tension circuits under working conditions were suddenly broken showed, however, that while the arcs produced with air-break switches were tremendous in size and continuity, yet with oil-break switches up to the limits of voltage used in practice, the arc was almost entirely wiped out. It is because of this that the oil switch can be relied upon as a circuit safeguard.

The tendency of modern switching development is to make all operations automatic. In large capacity switches this is accomplished by use of small motors and properly devised springs. In smaller types, a plunger working in a solenoid, with a catch to hold the switch closed, may accomplish the purpose. A small snap switch on the front of the board is the means by which the auxiliary device is energized, green or ruby lamps being used to denote the open or closed position of the switches.

Another radical step in advance made possible by the system of auxiliary control is the automatic closing of machine switches when the machine is properly synchronized with the line or station bus-bars. This is effected by adding to the ordinary synchronizing schemes, a device to introduce a time element effect into the auxiliary switching circuit. To these developments the oil-switch lends itself most readily, and from its extended use to-day it seems safe to say that as tensions increase with the distances of transmission, it will be the oil switch, perhaps in a higher state of perfection, upon which transmission manipulation will solely depend.

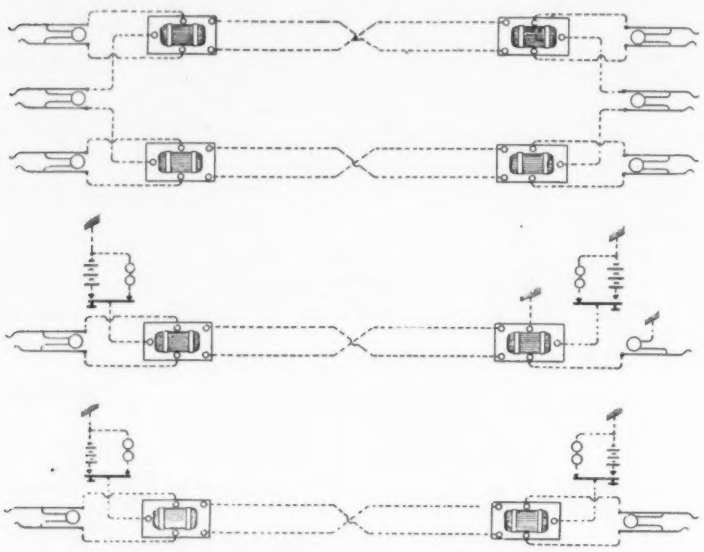
Telegraph and Telephone Over the Same Line.

By K. Weman.

IN the July 5th number of Electrical World and Engineer appeared an abstract of a paper read at Dublin before the Institute of Electrical Engineers, on "Railway Blocks and Telegraphs; Recent Practice," referring to combinations of telephone and telegraph on the same line. This is not very recent practice in other parts of Europe, as by using duplex transforming several combinations have been made with very satisfactory results, not only with the object of removing inductive disturbances, but also, and more so, in order to get as much service as possible out of the lines. This has especially been the case on telephone toll lines where it is a matter of getting as much interest as possible on the capital invested in expensive lines.

As remarked in the paper, the line branches must have the same resistance. This is easily balanced by a rheostat, but what is more important, the transformers must be perfectly balanced in every respect, and the loss of efficiency a minimum.

The National Telephone Company, in England, after much experimenting, obtained very satisfactory results and have been using the duplex transformer for several years on their lines. In the Scandinavian countries they are also used extensively, and with excellent results. For instance, on a busy toll line where every period of four or five minutes is worth a certain amount—say only 20 cents for a five-minutes' conversation—the operators use, as a



FIGS. 1, 2 AND 3.—TELEGRAPH AND TELEPHONE ON SAME LINE.

minimum, one minute (generally they use much more) for clearing the cords and arranging the next connection. We have thus ten periods of five minutes and ten minutes' service in every hour. Say that five minutes thereof are necessary for the switching; we lose one period, or 20 cents. If the toll line is open for service eight hours per day, it means a loss of $1.60, or on an average of $40 per month. On the other hand, if duplex transforming is resorted to, the operators may use the phantom circuit for arranging the conversation, and have time to get the next party as well, while conversation is going on on the line proper; and, therefore, when the clearing-out signal is given, the next connection is made without any "palavering" between the operators, or any loss of time.

Or take a less busy toll line, where the minutes need not be counted and the operator has ample time to get through the service on the same line. By putting in duplex transformers at each end, a phantom circuit is obtained, which may be rented to a broker or a newspaper for exclusive use. Now, if the broker or paper should talk ordinarily over the toll line, says five times per day at the rate of 20 cents per conversation, it would cost him daily $1. If the phantom line is rented to the party at $20 per month, he saves $10 per month, and the exchange has no extra maintenance or switching to do, but makes a clear profit of the rent.

Another combination is to use two railway telegraph lines, and at each station have two duplex transformers with a Morse set between the neutral points. A bell and a telephone are then used as a block system between each two stations. This reduces the resistance of the telegraph line considerably, and the telephones are all working on metallic circuits.

Referring to the diagrams, Fig. 1 represents a metallic toll line through duplex transformers, terminating at both ends in metallic jacks in a board and the phantom line in a telegraph instrument used for service between the operators, or rented. Or instead of the telegraph instrument, another pair of jacks and drops, with ground as return, may be had.

Fig. 2 shows a similar line between two places, the one having metallic circuit, the other single line subscribers. In this case there might be some disturbance on the single lines, but this may be overcome by using an ordinary transformer between the duplex and the jack.

In Fig. 3 are shown two toll lines passing through two duplexes at each end, whereby a third metallic line is obtained. This is extensively used, and gives excellent results. It is evident to what extent time and money are saved where the two lines are expensive and very busy, not to speak of the complete metallic line which may be had at the expense of four transformers. In Fig. 4 a step further is taken, and we have here not only the three metallic circuits but a telegraph circuit besides.

In one of the largest combinations of this kind installed there were eight single lines, or four metallic circuits, out of which were taken six metallic circuits and two single lines. There is, theoretically, no limit to the combinations, but in case the balance is upset in some way, the whole combination is useless, and it is, therefore,

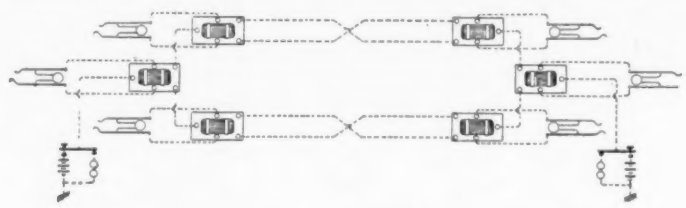


FIG. 4.—TELEGRAPH AND TELEPHONE ON SAME LINE.

seldom carried further than to the two metallic circuits. In case one of the lines should get out of order, the transformers may be switched out, and if then one line should be faulty the other may still be used as an ordinary metallic line.

An Idaho Water-Power Plant.

A water-power plant for the supply of current to Boise, Idaho, is nearing completion, and is expected to be in operation by October.

The foundations of the power house are of cement and laid six feet below low water mark. The water-wheels rest on a massive wood floor, which is laid on a solid natural gravel foundation.

The canal is 34 feet wide at the bottom and carries water 6 feet deep, and is 3½ miles long, a considerable portion having been built through solid rock which had to be blasted out, requiring much time and great expense. The canal is now entirely completed ready for use. Five concrete conduits run under the canal at different places, to carry off the storm water, which is not allowed to enter the canal.

The pole line to Boise is being pushed toward completion. It is expected that the line will be completed the entire distance to the power house (21 miles), with a two-mile branch to Peorle, by August 15. The company has secured a lot in Boise where work will begin shortly on a sub-station fire-proof building, 25 x50 feet in dimension. This building will be the Boise headquarters of the company, where the main transformers will be located.

The current, which enters the building direct from the power plant, will have a voltage of 20,000. By passing through the step-down transformers it will be changed to 2,000 volts and less as may be desired.

Three cars of machinery, consisting of two 15,000-hp turbine water-wheels of the latest Leffel pattern, with shafting, belting, etc., are on the ground. The wheels are of the horizontal pattern, and will be connected direct with the two generators. The generators are each of 500-kw capacity, made by the Westinghouse Company. They are of the very latest design, and weigh 65,000 pounds each. They will be completed in time to reach Boise by Oct. 1. The order was placed six months ago. The exciter will be on the same shaft with

the generator. The water power will be controlled by Lombard governors.

The two wheels now on hand will be installed early in August. Room for a third has been provided, but it will not be put in until more power is in demand than can otherwise be furnished.

The current will be brought to Boise on three separate uninsulated cables. Each cable is made of seven strands of aluminum wire, twisted and held firm by small bands of the same material. The splices are made by means of an aluminum sleeve, which is cramped tightly around the ends, thus forming a complete connection. The plan of using aluminum was an afterthought. The company had purchased 25 tons of copper wire some time ago, which was sold recently at a neat profit. The wires are placed on either side and are on the tops of the poles, making an equilateral triangle.

The company installing the plant, the Electric Power Company, Ltd., is composed of local capitalists. The officers are H. O. Pope, president; H. D. Pope, vice-president, and M. D. Dobson, secretary.

Safety in Elevators.

By O. F. Shepard.

The article under this same head which appeared in the issue of this paper of July 12, is of much interest to those familiar with the construction and operation of electric elevators. It gives, however, an impression, first, that electric elevator accidents are very numerous, and second, that one of the frequent causes is the lack of retarding torque in a compound-wound motor when driven as a generator by the load on the car.

On the contrary, to one who has given the subject any study, the very few elevator accidents, in proportion to the number of elevators in operation, is really a great surprise, especially when one considers that nine-tenths or more of elevators installed receive no other attention than that given them by the janitors of the buildings where the machines are situated. Furthermore, it is very unlikely that the cause of the accident mentioned was due to the reasons set forth. Not knowing the particular type and make of the machine in question, conclusions can be drawn only from the duties of some of the standard makes.

The efficiency of electric elevators ranges between 45 per cent. and 75 per cent., reaching 75 per cent. only under the most favorable circumstances; 60 per cent. would be a high average. Suppose we assume for a problem, an elevator requiring 100 amperes at 220 volts to raise its maximum load. Then of this 100 amperes at 60 per cent. efficiency, only 60 amperes are actually used in lifting the load, the other 40 taking care of the losses in the motor, in the worm or other gearing, and in the friction of journals, cables, guides, etc. Now, in descending, the same load is capable of yielding the equivalent of the 60 amperes (at 220 volts) of energy. Assuming the efficiency of the machine when driven backward to be the same, *i. e.*, 60 per cent., we then have 36 amperes given back to the line—a little over one-third of the maximum capacity of the motor. In reality this will be less, for the efficiency is less when the machine is driven backward, or when the motor acts as a generator.

The writer has tested some machines which gave 75 per cent. efficiency when lifting maximum load, but which gave back to the line when the same load descended but one-third of the current required in lifting, the voltage remaining practically constant. From numerous tests of electric elevators it is found that a retarding torque of one-third is sufficient for every case, and in the majority a much less torque would suffice to restrain the maximum load, and prevent a runaway.

This brings us to the question as to when a differentially-wound motor becomes a motor of constant torque—a point which was also raised in the article mentioned. Assuming the magnetization curve to be a straight line, we readily see that the ampere-turns of the series winding at full load must equal two-thirds of the ampere-turns supplied by the shunt winding, in order that the motor when driven as a generator (within practical limits) may act with a constant torque of one-third that yielded when the motor is acting as a shunt motor. This, then, would be a limiting value for the series winding of an elevator motor, and being the limit it would not be safe to leave in circuit such a series winding to act differentially. But if the series winding at full load equalled in m.m.f. but half the shunt m.m.f., the motor would readily supply the necessary retarding torque without much increase in speed.

Take the example above of the 100-ampere machine. Consider it to descend and generate 40 amperes back current. Then, as at 100 amperes the series field equals one-half the shunt, at 40 amperes it would be one-fifth of the shunt; therefore, the effective m.m.f. would be four-fifths normal, and assuming strength of field to decrease proportionately, the motor would run at 25 per cent. over speed. This 40 amperes with field four-fifths as strong would give the required one-third torque. It will be found, however, to be greater than this, and the speed will not increase 25 per cent., for, as is well known, the magnetization curve rises above a straight line. However, it is not thought that any responsible elevator concern uses a series winding of so much as 50 per cent. of the shunt winding upon its motors, after they are started. Generally but 25 per cent. to 35 per cent. is permitted to remain in circuit.

There is, however, a source of danger in descending with heavy loads on an electric elevator. This is when after starting, the power supply circuit is opened, either in the supply feeders by the opening of the wall switch, or by a poor contact in the elevator controller. In this case there is no limit to the speed of the motor, even if purely a shunt mtor, because it can speed up and generate an exceedingly high voltage; but there being no circuit to which to supply current, there is practically no resistance to rotation. An opening of the circuit in some such way, or perhaps an opening of the shunt circuit of the motor, was no doubt the cause of the accident mentioned by Mr. Rennerfelt in his article. It seems that the only means to prevent a runaway in such a case is in the use of a speed governor. But this is supplied with the safety catch upon the car, and so there is no need of adding another.

At this point it may be well to mention another very common fallacy regarding electric elevators. Many manufacturers maintain that an electric brake or an electric operating device will take care of just these cases of failure of power supply or the opening of the supply circuit; hence it is the general impression that a solenoid brake is safer than a mechanical brake, for it is thought that in case of failure of current supply, the electric brake would come on and stop the elevator, while the mechanical brake would remain off and permit the machine to run away, unless the operator had presence of mind to apply the brake. But in descending with load (or going up with empty car, which is heavily overweighted) in case the power supply fails, one of two things will happen—either the load will drive the machine and run the motor as a generator, or the car will stop. If the load drives the machine the motor will act as a generator and furnish current to the electric brake or to the electric operating device, and thus hold them in the running position and hence be no safer than the mechanical control.

"The Battle of the Tubes" in London.

A recent cable dispatch from London says: The "battle of the tubes," as the Morgan-Speyer contest for franchises to construct and operate underground lines here is termed, is going favorably to the Speyer group. Their bill was practically approved by the Parliamentary Committee, while consideration of the Morgan application was adjourned to the autumn session.

Before a special committee on the proposed London tube-railways Balfour Browne, K. C., said he wished to deny emphatically the report that the Morgan and Yerkes interests had combined. Personally, he said, he was altogether opposed to Mr. Yerkes's proposals. The parliamentary committee on the proposed tube-railways decided to make a report giving the Yerkes Underground Electric Railway all needed legislative right of way for the completion of its entire system. The Morgan company's bills to authorize the paralleling of the main portion of Yerkes's routes have been put over until next session.

The dispute between the Morgan and Speyer interests affects only some small connecting links in the London underground system. The Speyer-Yerkes franchise covers lines already in operation within the city; the Morgan group controls some outside transportation lines.

Sea Telephone Cable.

Connections were made last week on the new telephone cable across Vineyard Sound, between Vineyard Haven and the mainland, and communication by telephone was established. The cable is four miles long, with terminals at Nobscot Lighthouse and Lamberton Cove, near Vineyard Haven, opening on the Atlantic.

The Tube Electric Railways of London.

In the August 2 issue of ELECTRICAL WORLD AND ENGINEER a report was given of the proceedings in London of the International Tramways Congress, including an abstract of the interesting paper on "The Tube Railways of London," by Mr. P. V. McMahon, chief engineer of the City and South London Railway. We are now able to supplement the abstract by some further details from the paper, as to the results obtained on Mr. McMahon's road, which, with its extension is now about 6¼ miles long, and runs from Clapham Common through the city to the Angel at Islington, with 13 stations,

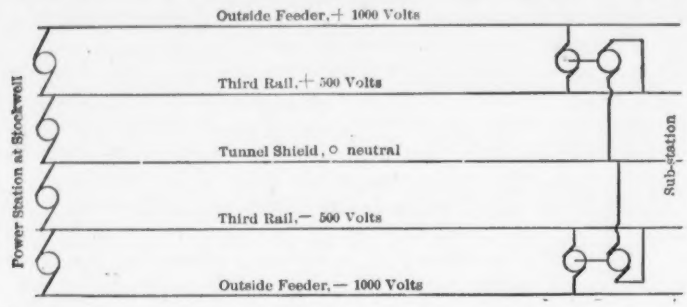


FIG. 1.—DIAGRAM OF DISTRIBUTION SYSTEM.

the average distance between stations being about 850 yards. The generating station is situated at Stockwell, about one mile from the south end of the line. Originally the line to King William Street was worked on the ordinary two-wire system at 500 volts, but with the extension north the two-wire system at 500 volts was no longer available, and the method of distribution was changed to the three-wire system with 1,000 volts across the outers, the running rail forming the middle wire. There are two sub-stations, one at London Bridge, 2¾ miles from Stockwell, and the other at the Angel, 5¼ miles from the generating station. These sub-stations are fed from Stockwell on practically a five-wire system, *i. e.*, 2,000 volts across the outers. A particular feature of the system is, that although distribution is effected at 2,000 volts, the maximum voltage across any one commutator is 500 volts and only half of the electrical energy sent to the sub-stations is transformed, and thus a high efficiency is maintained.

One or two novel points had to be settled before installing the system. In the first place, there had been the problem of getting from the negative to the positive side, and several automatic devices had been considered, but the way out of the difficulty had finally resolved itself into a simple break of 30 feet in the working conductor at the crossings. That had given rather a flickering light in the train, but the break had been reduced afterward to 15 feet by putting conduc-

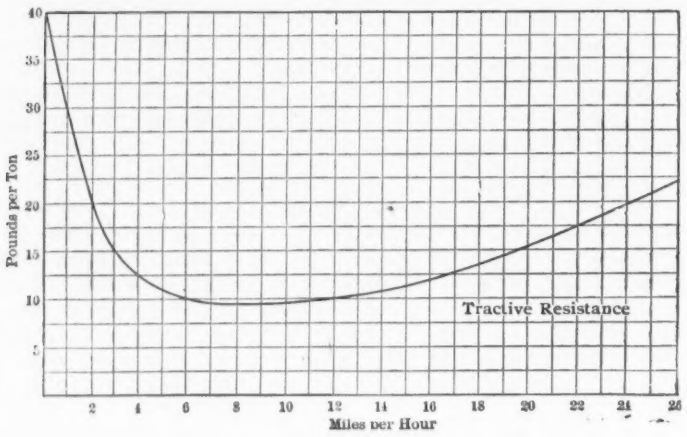


FIG. 2.—TRACTIVE RESISTANCE CURVES.

tors in the middle and a fuse between, so that if, by any chance, two locomotives were crossing and caused a short-circuit, the middle piece would become disconnected from the main conductor. Another question decided had been whether two machines should be used at 500 volts, one on each side of the system, or 1,000-volt machines across the outers, with smaller machines for balancing. Many things had pointed to the use of generators working at 1,000 volts, but one point that had seemed to be very important was that a bad short-circuit, such as might be caused by a car running off the road and directly connecting the third-rail to the ordinary running rail, might raise the pressure to 1,000 volts between the running rail and the working conductor. The circuit-breaker would probably work, but in the meantime the pressure might be raised on the motor and lamps, and a lot of the lamps would be blown out by the temporary rise in voltage.

As to the sub-station efficiency, it may be mentioned that the continuous-current, high-tension reducers have an efficiency of 90 per cent. at quarter load, 94 per cent. at half load, 96 per cent. at full load, and about 96 per cent. at 50 per cent. overload. This high efficiency is especially noticeable at the sub-station at the Angel, where the high tension reducer system with reversible boosters in connection with a large battery was in use; a very high efficiency, indeed, was obtained, because the high-tension feeders supplying the sub-station at 1,000 volts had an almost steady load all day long of between 75 amperes and 80 amperes, while the current going from the sub-station bus-bars to the line varied between zero and 450 amperes. If a system of that sort were applied all over, the size of the units in the generating station and the size of feeders could be reduced for the same number of trains. At London Bridge sub-station there was a battery almost as large, but it had failed to take the peaks with the ordinary boosters, and was not much good as a regulator; in fact, it would do very little work at all, unless additional cells were switched in and the battery was allowed to discharge on the whole. It was used in case of a heavy load, and the cells had to be switched in to make a discharge.

The elevator and lighting circuits were fed from the same bus-bars,

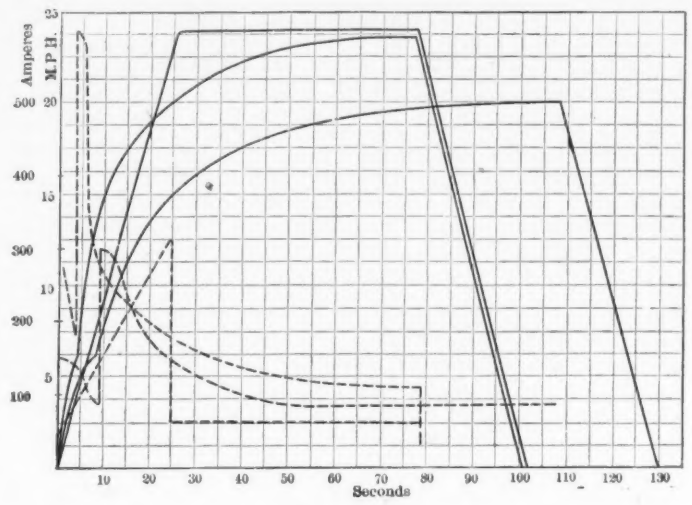


FIG. 3.—STARTING CURVES WITH TWO AND FOUR-MOTOR EQUIPMENTS.

but in the case of a heavy short-ciruit on the working conductor an automatic cut-out operated, and threw the lifts and lights onto the battery, thus maintaining the station lighting and lifts supply in case of the working conductor blowing its fuses.

Comparing the continuous-current, three-wire system used on the City and South London Railway with the three-phase system, it would be seen at once that a good deal less needed to be spent in copper, on account of the steady load on the feeders. There was very little difference in the rail drop between 5¼ miles and about three miles, and it would seem that the limits for the three-wire system had not, by any means, been reached. Previous to the installation of the system it had been thought there might be some difficulty in the balancing, but none had occurred. Ordinary balancers were installed at Clapham Common, Moorgate Street and the Elephant and Castle, and it was found that the continuous-current reducers acted so well as balancers that only one of the balancers needed to be used. The ammeters in the reducer motor armature circuit at the sub-station showed that the current was fairly steady, while the generator armature currents were varying from zero to the maximum, showing that they were acting as balancers as well as reducers.

The present City and South London trains consist of four bogie carriages, having a total seating capacity of 128 passengers. The empty train weighs 28.16 tons, and 36.16 tons fully loaded.

The locomotives are each fitted with two gearless motors, one of which is capable of doing the work in case of the other getting temporarily disabled. The locomotive weighs complete 13.65 tons. Thus, the locomotive and fully loaded train weigh 49.8 tons. The maximum number of trains running at one time is 25, giving a ser-

vice slightly under three minutes between trains in busy traffic. This service is reduced to about 18 trains during the periods of light load. The average speed, including stops, is 14.4 miles per hour, and, excluding stops at stations, 16.75 miles per hour.

The kw-hours per ton mile at the above speed measured on board the locomotive are 0.0552. At the generating station switchboard the unit per ton mile for the past half year was .068. This figure includes shunting, sub-station and cable losses, which are not, of course, included in the measurement on board the locomotive. For the same period the number of train miles run were 650,000, and the passengers carried about 9,000,000. The coal per unit generated was 3.9 lbs., which includes all boiler house losses, getting steam and banking fires. This result was obtained with North Country and Midland small coal. With a coal of a slightly higher calorific value, during a month of this period, the coal per unit (kw-hour) was 3.28 lbs., including all boiler house losses.

Expressing this result, as in steam railway practice, we get a coal consumption of about three ounces per ton mile, which compares favorably with main line practice, when one considers that published steam locomotive tests are specially taken and over a short period only. Also the traction resistance in tunnels, as shown by exhaustive tests on the South London line, is about double that which obtains on main lines, and short sections, which means that the train is being accelerated for about half the total running time. The output in Board of Trade units per half year is 3,781,000. The tractive resistance per ton in the City and South London Railway is given in Fig. 2.

While on the question of speed it may be well to discuss the matter of very rapid acceleration, which is receiving a lot of attention at the present moment. When the present South London locomotives were designed, it was carefully considered how far the company could go in the direction of rapid acceleration without paying too much for it. It was found that with the locomotive under consideration, locomotives and trains weighing about 49 tons with passengers, the time taken on a short section of 2,700 feet would be 130 seconds, the maximum speed being 19.7 miles an hour, and the units per ton mile 0.054, with an average speed of 14.25 miles per hour. It had been thought that a much better service might be obtained by having a four-motor equipment, the total weight remaining at 49 tons, but with a reduction in seating capacity. The units per ton mile were reduced to 0.0377, the maximum speed was 20.6, and the average 14.25 miles per hour, as before. This reduced units per ton mile were obtained by increasing the acceleration, but the peaks at starting were increased from 300 amperes to 600 amperes. That had a very important bearing on the size of a generating station, and the copper in feeders and the size of the working conductor. The results given above assumed that the current could be shut off as soon as full speed was obtained and the locomotive allowed to coast, but that would hardly apply in practice. Running the above locomotives at their maximum speed and keeping the current on until the brakes were applied, the times for a 2,700-foot section were 122 seconds and 103 seconds, while the units per ton miles were 0.0659 and 0.0745, respectively. Considering this effect on the power station of a line with ten such sections, allowing ten seconds at each station, and running a two-minute service with 30 trains leaving the terminus per hour, we find that the maximum current demand was 2,085 amperes, and with four motors, 4,300 amperes. The time for the journey with the two-motor equipment was 21.8 minutes, and with the four-motor equipment 18.67 minutes. The difference was an increase of 13.5 per cent. in the units per ton mile, with the higher acceleration, and the power house had to be enlarged by 63 per cent., while only 14.3 per cent. was saved in time. Unless the competition with trams and other means of locomotion was very severe, such extra expenditure, in order to obtain very high rates of acceleration, was not warranted. Another thing was that the power turned out would not be turned out so economically with a very varying load. It would almost appear that when a very rapid acceleration was required some such system as the Ward-Leonard system, where there were not very high peaks, would meet the case, although it had not been tried.

However, the diagram (Fig. 3) shown illustrates the results of such a system in comparison with the two and four-motor equipment above referred to. The starting current is much lower, and a uniform acceleration obtained. Compared with the four-motor equipment the time for the section is the same, but the four-motor consumes less energy, taking 98.6 watt-hours, as against 105 for the Ward-Leonard; but the latter requires a maximum current of only 318 amperes, as against 600 amperes for the four-motor equipment. The two-motor equipment requires the same energy as the Ward-Leonard, but takes 20 seconds longer to run the section.

A practical example of the effect of very rapid acceleration may be found in the new motors on the Liverpool Overhead Railway, where the old motors took starting currents of 140 amperes to 150 amperes for an average speed of 12.5 miles per hour, and the new motors 700 amperes to 800 amperes, the average speed being 19 miles per hour. The time for the journey is, however, reduced from 32 to 20.9 minutes. The increased generating plant, feeders, etc., is no doubt justified by tramway competition.

Electric Railway Patents.

The budget of patents of July 22 was unique in that it consisted almost exclusively of patents relating to the electric railway. Six of the patents were assigned to the General Electric Company, the patentees being W. B. Potter, E. M. Hewlett, F. W. Hill, S. B. Stewart, Jr., and C. E. Barry. One of the three Potter patents adds another to the numerous devices for averting the evil effects of arcs at switch points. The present device is specifically a detail in sectional conductor switches, and consists of a means of separating the switch contacts when they may be welded or stuck together by arcing. The principal feature of the invention is the arrangement of the plunger and switch arm in such a way that there is lost motion between the former and latter, so that the plunger in descending strikes a hammer blow on the switch arm, which is more effective in separating the stick jaws than if the moving parts wer all one piece. Another Potter patent relates to a blow-out magnet device, applied to sectional conductor systems, the principal feature of which is to make the blow-out magnet core of steel, having a high coercive force so that it will remain permanently magnetized after the line current has ceased. The object is to give the magnet greater strength than it would possess in virtue of the line current alone, in order that it may successfully extinguish arcs that occur when the line current is small; for if the core were built of soft iron the line current would not magnetize the magnet sufficiently strong in this case to blow out the arc. The third Potter patent is on a three-jaw switch, also for a sectional contact system. It covers a number of convenient features of construction in combination with a three-jaw switch. These features relate principally to resiliently mounted jaws, reducing the hammer blow, a closed secondary around the magnetic circuit to reduce the reactive kick of the bobbin, non-magnetic tips to the electromagnetic air gap to prevent sticking, and similar well-known devices, all being claimed in combination with this particular type of switch.

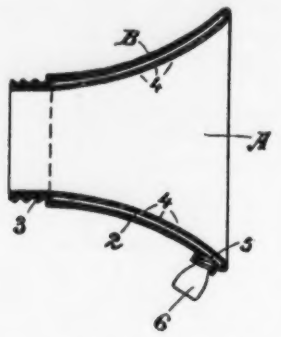
Still another patent relating to the sectional conductor system was issued to E. M. Hewlett. This invention has for its object the improvement and construction of switches used in sectional conductor work. The important features of the improvement are a semi-universal joint for the moving contact members so as to enable them to adjust themselves to a truly accurate position with reference to stationary jaws; an arrangement permitting the contact members to have lateral play for the same purpose; and means for draining the bottom of the electromagnetic solenoid of condensed moisture.

A patent, issued to F. W. Hill and S. B. Stewart, Jr., relates to improvements in the underground conduit system of electric railways. The invention has reference to means whereby covers in the conduit can be automatically raised by the car itself to enable the inspection and repair of the plow. It consists essentially of a system of levers, arranged to be engaged by the car collector and thereby operated to move a cover in the conduit so as to enable the shoe to be inspected.

Certain details of a train-control system are the subject of a patent issued to C. E. Barry, the object being to render the action of the sub-controller more certain. The pilot motor which actuates the sub-controller is controlled by magnetic switches actuated by a current in the main motor circuit. The action of the controller to the extent desired is made to depend upon the rotation of the switch itself. The claims are quite broad and cover means for operating the controller whenever the current in the motor exceeds a certain amount, which means may be controlled in part by current in the motor circuit, and in part by the master pilot controller in any desired combination. In the arrangement shown, the pilot-motor circuit is open-circuited by the electromagnetic switch whenever the current rises above a certain value, thereby preventing the pilot motor from advancing the controller further.

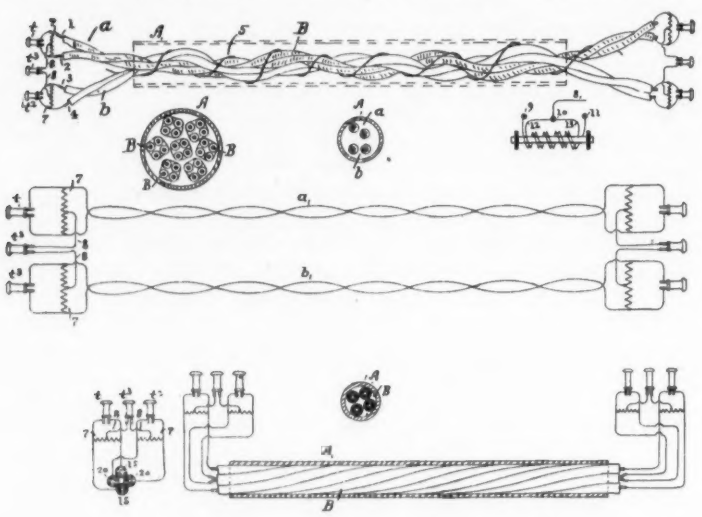
New Telephone Patents.

The issue of the Patent Office for August 5 contains four telephone patents, three being of distinct interest. The belief that is held by many that the mouthpiece of a telephone transmitter may be the means of communicating disease has impelled Mr. William M. English and Mr. George A. Burns, both of San Francisco, to conspire together to invent an antiseptic telephone mouthpiece, which consists of a double mouthpiece joined together at the inner and outer edges so as to form a circular space or chamber. The inner mouthpiece or lining is pierced with holes, and to the outer is attached a small receptacle containing any antiseptic or sterilizing material which will vaporize and fill the interspace between the double sides of the mouthpiece and be discharged through the holes in the lining of the mouthpiece. The drawing illustrates the device quite clearly. *A* and *B* are the inner and outer shells, of the usual form; *A* being pierced with a series of holes, 4, and *B* having a single opening, 5, at its lowest point, to which is attached the receptacle, 6, for the antiseptic material. The vapor arising from this and passing through the numerous holes in *A* "will act to sterilize and destroy any products which may be deposited within the mouthpiece from the breath of the persons using it, so that the danger arising from subsequent use of a mouthpiece will be avoided. The receptacle, 6, can be recharged at any required interval." Should this device be adopted to any extent, a delicate job will be added to the work of the instrument inspector in the refilling of the receptacle 6. It seems to be overlooked that should the vapor fail from the contents of receptacle 6, or should receptacle 6 be allowed to become and remain empty, the perforated lining, *A*, and the inner space are admirably adapted to collect and retain "any products which may be disposed within the mouthpiece," and the last state of that mouthpiece would be worse than the first.



ANTISEPTIC MOUTHPIECE.

The issue of a patent to Marcia J. Farnham, as administratrix of Isaiah H. Farnham, recalls the horrible tragedy of which Mr. Farnham was a victim about a year ago. The invention which Mr. Farnham filed with the Patent Office shortly before he was killed relates to a telephone circuit in which a phantom circuit is obtained, enabling two pairs of conductors to be used for three telephone circuits. In Mr. Farnham's specification he traces the adoption of metallic circuits, and points out that "as the art of telephony broadened out composite circuits were devised in which telegraphic and telephonic services were performed upon the same circuits and also composite circuits were arranged for telephone service whereby the conductors of two telephone-circuits were employed as the limbs of a third telephone circuit, which are known as phantom circuits." In obtaining his phantom circuit, Mr. Farnham takes each two pairs of conductors in a telephone cable and twists them together in a reverse direction to the twist of the conductors. Each set of two pairs when twisted is bound with a thread of some distinctive color in order more easily to identify the pairs, and the whole of the conductors when thus arranged in sets of two twisted pairs are formed into a core within the sheath in reverse layers. Each two pairs of twisted conductors constitute a unit, which when the cable is in place is adapted to form three independent circuits, *i. e.*, the two metallic circuits and a third or phantom circuit in which the conductors of each metallic circuit are employed as one limb or conductor—and in a thirty-pair cable there will be 15 such units and 15 phantom circuits. By means of the invention it is possible greatly to increase the circuit capacity of a cable and obtain completely balanced circuits in each of the said units in their relation with one another and in relation to the powerful foreign currents conveyed upon conductors strung in proximity to the cable.



FIGS. 1 TO 6.—FARNHAM TELEPHONE CIRCUIT.

In the drawings, Fig. 1 is a view in diagram of one unit of the improved cable, and Fig. 2 an end view. Fig. 3 is an end view of a cable having a plurality of such units. Fig. 4 is a diagram of an impedance coil, and Fig. 5 is a diagram of circuit connections. Fig. 6 is an end view of a modified cable, and Figs. 7 and 8 are diagrams of the circuit connections of Fig. 6. In Fig. 1 the two pairs *a* and *b* of paper insulated conductors are shown twisted together reversely to the twist of the pairs and held by the thread 5. At each end the conductors are bridged by an impedance coil, 7, and from the center, 10, of the coil-windings wires 8 extend to telephone t^3 to form a third or phantom circuit, of which the pair *a* forms one side and the pair *b* the other side.

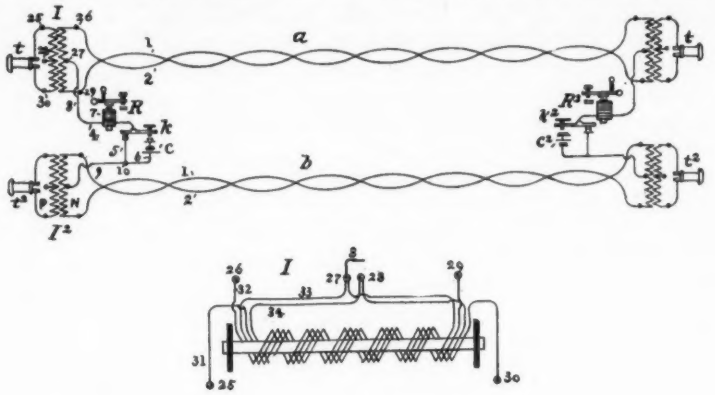
Fig. 4 shows in diagram the windings of the impedance coils, 7, the helices of which are wound on in parallel, and the outer ends, 9 and 11, are connected to binding posts, while the inner ends, 12 and 13, are connected to the bridging-post, 10, and the circuit from 9 is from the binding-post, 10, by one winding and from said post to 11 by the second winding. In operation the currents from the instruments *t* in, say, the circuit *a*, circulate through the helices of the coil winding in series and have an inductive effect upon the core of the coil, while the currents from the instruments t^3 circulate by the connecting-branch, 8, to the center of the helices of the coils and thence through the said helices differentially to the circuits *a* and *b*, and have no inductive effect upon the cores. The coils are thus wound so that a perfect balance is obtained between the two conductor metallic circuits *a* and *b* and the third or phantom circuit, *c*.

The specification says that in the experiments that were made previous to this invention it was found impossible to obtain quiet phantom circuits with the ordinary type of cable having twisted pairs arranged in reverse layers, as there would in all cases be more or less "cross-talk," but by the formation of two pairs of such metallic circuits into units it has been found that phantom circuits connected between the pairs of such units are quiet and without perceptible cross-talk or disturbances of any kind.

Two patents are issued to Mr. Martin H. Howell, of Melrose, Mass., bearing on the same general subject as the Farnham patent, and, like it, are assigned to the New England Telephone and Telegraph Company. The Howell patents both refer to composite circuits and depend upon a peculiar type of repeating coil of Mr. Howell's invention. Fig. 1 shows Mr. Howell's composite circuit, Fig. 2 the repeating coil and Fig. 4 an arrangement of circuits by which from two metallic telephone circuits are obtained both a phantom telephone circuit and a phantom telegraph circuit. Referring to Fig. 2, showing the form of repeating coil used, 31, 34, 32 and 33, are insulated conductors which are twisted together and have their right hand ends respectively brought out to the screw-posts 28, 30 and 29, and their left hand ends to the screw-posts 25, 28, 26 and 27, respectively, so that each conductor passes through the coil in two windings in series with one another, the points 27 and 28 being in the center of the respective windings, both sides of which are balanced and symmetrical. These coils are indicated in Fig. 1 and in the other figures by the reference letter *I*, and the extensions, 8, from the point, 27, on the side, *N*, of the coils at each end of the circuit, *a*, connect with the

electromagnet of the sounder, *R*, and then to the keys, *K*, of the telegraph apparatus, *I*, whose back and front contacts are connected by wires 5 and 6, with the extensions, 9, from the point 27 of the repeating coils, I^2 of the circuit *b*. Batteries *c* and c^2 are included in the wires 6 at each end of the main circuit. By this arrangement the circuit *a* serves as one side or limb, and the circuit *b* the other side or limb of the telegraph line. The telephones, *t* and t^2, are in a local circuit, comprising one side or winding of the repeating coils *I* and I^2. In the operation of the telegraph apparatus, when the key is pressed current from battery *c* passes by conductor 8 to point 27 on the *N* winding of the coil, where it splits, going through the helices in opposite directions and coming out at the points 26 and 29, and continues over the respective conductors 2 and 1 to the points 26 and 29 at the opposite end of the circuit, and thence through the helices of the winding *N* of the coil in opposite directions to the point 27, where the current unites and continues by the conductor 8 to the helices of relay R^2, and in case of metallic circuit return, shown in Fig. 1, the current passes by the rear contact of the key to the sides of the metallic circuit *b* to the opposite pole of the battery, and in the grounded circuits, shown in other figures, the return is by the earth. As the current splits at the point 27 and goes in opposite directions through the helices, as described, one side neutralizes the other. Therefore no inductive effect is produced in the core, and, consequently, there is no disturbance in the telephones at either end, and when the telephone is used the currents generated thereby enter the *P* windings of the coil and traverse the winding thereof in series, and an inductive effect is produced in the core of the coil, and similar currents are induced in the winding, *N*, of the coil, which traverse the helices thereof in series, and are propagated over the conductors 1 and 2 of the circuit and pass through the helices of the winding, *N*, of the coil at the opposite end of the circuit and are inductively transferred to the winding, *P*, through whose helices they circulate in series, and are received by the telephone in the local circuit of the winding. The impedance of the telegraph instruments prevents any leakage through them of the telephone currents.

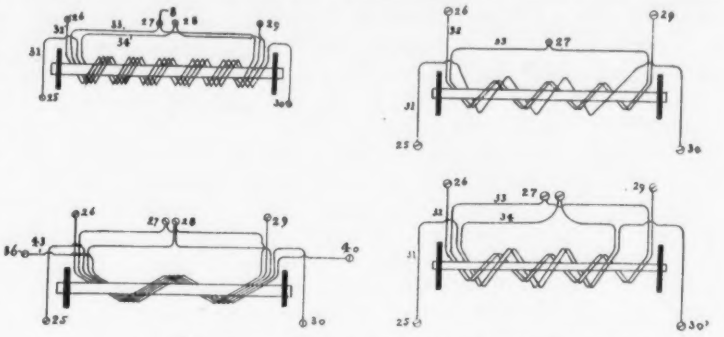
Fig. 3 shows the arrangement for obtaining both a phantom telegraph circuit and a phantom telephone circuit from two metallic circuits, a third repeating coil, I^3, being inserted between the points



FIGS. 1, 2, AND 3.—HOWELL COMPOSITE ELECTRIC CIRCUIT.

27 of the coils *I* and I^2 connected to the metallic circuits. The inventor further points out and illustrates that by connecting together the central points in the repeating coils in various telephone toll lines a continuous series phantom telegraph circuit may be obtained, serving a number of widely-separated places.

Mr. Howell's second patent also has reference to composite circuits and specially to a special type of repeating coil—considered an improvement over the impedance coil adopted in the Farnham patent—and the combination of the repeating coils in the line-circuit, by means of which the third or phantom circuits may be obtained. The repeating coils consist, essentially, of two separate windings upon a soft iron core. The helices of one winding are in series from one terminal to the other, and are inductive to alternating currents circulating through the second winding of the coil, and the helices are provided with two end terminals and also with a third central terminal. The helices of the second winding are provided with two end terminals and with a third central terminal, and the helices are inductive to alternating currents entering or circulating from an end terminal and continuing through the helices in series, but are non-inductive to currents which enter the central terminal, divide, and pass to the helices at either end of the said winding. Figs. 4, 5, 6 and 7 illustrate the repeating coil devised by Mr. Howell, the coil being substantially the coil shown in the previous patent and intended



FIGS. 4, 5, 6 AND 7.—HOWELL COMPOSITE ELECTRIC CIRCUIT.

to replace the impedance coil used in the Farnham patent. Referring to Fig. 4, the helices of the coil are composed of four conductors, 31, 34, 32 and 33, which are preferably twisted together, and their right-hand ends are respectively brought to the posts 28, 30, 27 and 29, and the left-hand ends to the posts 25, 28, 26 and 27, so that each conductor passes through the coil in two windings in series with one another, the points 27 and 28 being in the center of each of the two windings. Both sides of the coil are balanced and symmetrical. Fig. 5 shows a coil similar to that shown in Fig. 4, having a third winding which has a grounded branch, by means of which static line charges detrimental to good telephone work are provided with ground-escapes. All five wires are preferably twisted together before being wound upon the bobbin, and their ends are brought out as indicated. Fig. 6 shows a repeating coil, in which the two wires, 32 and 33, are twisted together before they are wound on the bobbin, but for sake of clearness are not so represented in the drawings, and the single wire 31 is then wound over them, and in Fig. 7 the two wires, 32 and 33, are twisted together and then wound upon the bobbin, after which the wires 31 and 34, which are twisted with one another, are wound above them. The application of the coil is shown in the previous patent. Mr. Howell claims it to be especially effective in producing a phantom circuit free from disturbance or cross-talk, even when circuits of unequal length are joined together, one of which is subject to the inductive influence of a strong current circuit—a condition well known to be peculiarly unfavorable to telephone working.

Electricity and Plants.

Another use of atmospheric electricity for plant growth is reported by Consul-General Guenther, of Frankfort. Speaking of Mr. J. Fuchs, a wine producer of Elba—presumably the island—he says: "He planted, some years ago, four fields with native grapevines, in the midst of a district infested with phylloxera, and treated two of these fields with 'air electricity.' The difference in the development of the grapes of the fields was apparent; those treated with electricity yielded better results, both in quantity and quality, and were not infected with phylloxera, while the other fields were. Mr. Fuchs has demonstrated, it is said, that electricity increases the fertility of the soil. It is not sufficient to simply conduct air electricity to the earth, but there should be a direct metallic connection of the electric conduit with the main stem of the plant. On a field of about 2½ acres, five masts are erected, the tops of which are supplied with an arrangement for accumulating atmospheric electricity. These accumulators are connected with each other by wires. Wires are laid in the soil about 1½ feet deep, forming an evenly distributed metallic net. Every accumulator is connected with this metallic net by a wire running along the mast. Short wires connect with the plants, the free ends being stuck into the stem or into the main root thereof."

Some New Electric Furnaces.

By Clinton Paul Townsend.

Three electric furnaces of the current patent issue represent the three classes into which such furnaces are usually divided—arc, incandescent and electrolytic; it is characteristic, however, of the looseness of a classification based upon the form taken by the current in traversing the heat zone, that in the absence of a knowledge of the charge under treatment it would be impossible to determine the fact from the structure.

The arc furnace, designed for the production of calcium carbide, reverts to the original crucible and vertical electrode type of Willson, with the additional feature, adopted by many of Willson's successors, of a slow and constant rotation of the pot to distribute the otherwise localized heat of the arc over the charge. A further feature, and one possessing both merit and originality, is the form of the vertical electrode—a flattened or ovoid carbon pencil extending diametrically across the rotating pot, and hence traversing every portion of the surface of the charge twice in each revolution. The construction is due to Arthur Parker, of Chorley, England.

The incandescent furnace is a modified form of the Taylor carbon disulphide furnace, described and figured in the Electrical World and Engineer, issue of December 21, 1901. In the construction then described the current was introduced through opposing electrodes, over and between which divided conductive carbon was fed, the heat developed therein determining the combination of the sulphur and carbon of the charge. According to the present modification the opposing carbons are omitted, and the broken conductive carbon is fed to the furnace through carbon conduits; it is to these conduits that the electrical connections are made. A further improvement consists in carrying the heat zone nearer to the base of the furnace, with the result that it is found practicable to tap off the accumulation of slag resulting from the impurities in the charge. This type of furnace is an assured success, the output of carbon disulphide from the electric furnaces of the Penn Yan installation having exceeded 3,000,000 pounds to date.

In the electrolytic furnace, the invention of August Voelker, of Cologne, Germany, the electrolyte is molten glass, and the heat is developed therein by the passage of an alternating, or, it is said, of a continuous current of electricity, between carbon electrodes. The purpose is to maintain the glass for a considerable time in the state of complete fluidity essential to settling and clearing. The furnace bears a general resemblance to the structure already figured in these columns (May 10, 1902), the chief differences being that the arcs employed for the preliminary melting of the charge are arranged in radial channels which converge to the refining tank before mentioned, and that the heated gases from these arcs are burned beneath the working-out basin.

Prevention of Cable Cutting.

The United States and Haytian Telegraph and Cable Co. has appealed to the State and Navy Departments to prevent the cutting of its cable at Cape Haitien. According to information received in New York the Haitian gunboat Crete-a-Perriot, which is under the command of Admiral Killick, who has allied himself with the revolutionary government under General Firmin, and who has been appointed Secretary of War and Navy under the revolutionary government, intends to sever the company's cable between Cape Haitien and New York. The company appealed to the authorities to instruct Commander McCrea, of the gunboat "Machias," to protect the cable from violence. Acting Secretary of State, Adee and Acting Secretary of the Navy, Darling, held a conference and decided that it was proper for this government to issue the instructions, and accordingly a cablegram was sent to Commander McCrea, directing him to prevent the cutting of the cable. The Haitien Cable Company is understood to be a French concern, and under ordinary circumstances its interests would be looked after by the French Government, which has the "Suchet" and several other war vessels in West Indian waters. But the company has American affiliations, and a large amount of American business passes over its lines. Some of this is for the United States Government, which uses the line in part to maintain its communication with war vessels at various points in the West Indies. It also is a partial dependence for government communication with Porto Rico. The State and Navy Department officials felt that protection of this cable came within the general policy of protecting American interests.

CURRENT NEWS AND NOTES.

METRIC SYSTEM FOR THE EMPIRE.—A cable dispatch from London, of August 12, says: The final meeting of the Colonial Conference was held yesterday in the Right Hon. Joseph Chamberlain's room, at the Colonial Office. A resolution adopted provides for the metric system of weights and measures throughout the empire. The proceedings of the conference will not be published, but the resolutions adopted will be issued in a parliamentary paper.

MARCONI AND SOLARI.—The following cable dispatch from the Marquis Solari gives, as we indicated last week, just what is the truth of the situation, and vindicates Mr. Marconi from the absurd and atrocious insinuations against him: "London—Utterly untrue that Marconi has acknowledged that I am inventor of his wireless telegraph system or that the accessory invented by me, which, by desire of the Italian Government, was provisionally protected in Marconi's name, is necessary or important for his system. I make no such claim. It is a mere accessory. I am here buying Marconi apparatus for the Italian Government. Letter follows."

INDUCTION MOTOR METER.—From Canada comes an invention in induction motor meters, accredited and patented to Mr. G. L. Gowland, of Peterboro. One object is to provide a meter having a large range and provided with a rotating armature that shall run at a speed exactly proportionate to the amount of current passing through the meter. Another object is to provide a meter which will work equally well with either inductive or non-inductive loads. This meter, Mr. Gowland remarks, should not be confounded with any meter having the usual so-called "90-degree lag," or any similar phenomena. It differs from such a meter in this respect—namely, that the flux produced at the poles of the magnets on the so-called "voltage" side of the meter is a stationary flux and is not of a revoluble nature. He obtains the rotation of the disk partly by using a so-called "voltage-magnet," the core of which is split into two members and a flat bar of copper inserted there-between. Mr. Gowland states that he has found that a flux-plate composed of thin sheets of laminæ or copper disposed in planes parallel with each other and also parallel with the plate when excited by a magnet in immediate proximity to said plate produces a considerable rotative effect. This effect appears to be governed largely by the amperage rather than by the voltage of the current. With a meter of the type described, the aluminium disk need not be placed so near the magnet-poles as is required in most other meters. This fact presents the considerable practical advantage that particles of dust or dirt accumulating upon the plate do not interfere with its action, and any slight distortion of the disk is less objectionable than is the case with ordinary meters.

POLE-PIECE EXTENSIONS.—Mr. J. M. Burke, formerly one of the designers of the General Electric Company, but connected for sometime past with the Bergmann interests in Germany, has just taken out a patent on an ingenious improvement in dynamo pole-pieces. It is a well-known practice to provide the pole-pieces of dynamo-electric machines with extensions forming enlarged end surfaces in order to cover a greater portion of the armature-surface than would be covered were the cross-sectional area of the end of the pole-piece the same as that where the magnet-winding is supported. Various arrangements of such polar extensions are employed; but the most common construction comprises a separate extension bolted upon the end of the pole-piece after the magnet-winding has been slipped on. Such constructions, however, Mr. Burke holds, are objectionable, because the removal of the extension for the purpose of taking out the magnet-winding is often difficult without dismantling the machine and also because the extension cannot be brought to the highest degree of magnetic saturation, owing to the reluctance interposed by the cut between extensions and pole-piece and the fact that the extension is not directly surrounded and magnetized by the windings. Mr. Burke's invention, therefore, has for its object the construction of pole-pieces having enlarged end surfaces which shall be of the maximum magnetic intensity and also the provision of means whereby the extension may be readily removed to permit the insertion or removal of the magnet-windings. Several drawings are shown in which, generally, the pole-pieces are provided with angular offsets or recesses, into which complementary parts fit, which, when combined, form the pole-piece of the machine. Various ways of bracing these are also illustrated.

WATER POWER IN FRENCH ALPS.—A cable dispatch from Paris says: A prominent electrical concern of Paris, which is closely connected with the General Electric Company, of New York, is now securing all the water power available in the Department of the Alpes Maritimes, with the object of supplying electric light and power to towns on the southeastern cost of France. The company also hopes to supply power for the electric locomotives which the Paris-Lyons-Mediterranean Railway proposes to test on the Cannes-Monaco Railway during the winter.

CABLES AND WIRELESS TELEGRAPHY.—A cable dispatch from London, of August 2, says: At a meeting of the Anglo-American Telegraph Company yesterday, the chairman, Francis A. Bevan, said that nothing had occurred, so far as he knew, to alter the opinion of the directors, that although wireless telegraphy would carry a certain class of telegrams, such as those between ships, or between ships and the shore, there was no reason apparent why it would compete in the class of telegrams sent by cable companies. During a conversation the other day with Lord Kelvin, the latter said to Mr. Bevan: "I have given careful consideration to this subject, and I do not believe the shareholders of your company need be alarmed at the prospect of wireless telegraphy."

GERMAN TELEPHONE FIGURES.—The telephone service of Germany is carried on by the Post Office Department. According to an official report, the cost of the entire plant, up to April 1, 1902, amounted to about $42,000,000. Up to April 1, 1901, the cost had been $36,600,000. At the begining of the present year, 2,024 places had public telephone stations, with 322,281 miles of line. These stations averaged 2,205,966 conversations per day, or about 804,000,000 per year. The following cities have the greatest number of public telephone stations:

	Number.
Berlin	51,561
Hamburg	20,823
Frankfort	9,271
Dresden	8,914
Leipzig	8,725
Cologne	7,484

The total number of employes is 8,189, of whom Berlin has 1,712.

TELEGRAPHY IN ENGLAND.—A cable dispatch to the New York *Herald* from London, of August 9, says: "The young King of Spain is reported to have satirically remarked the other day that, while a hundred years ago it took a day to carry news from one given point in Spain to another, now with the telegraph, it took two days. Things are not much better in England. I referred last week to the extraordinary order given to provincial operators to have mercy on the poor, young, inexperienced telegraph operators of London and not send messages too fast. This order has raised a great storm, chiefly in commercial circles. Everybody wants to air grievances and tell how business is upset by the frequent delays of the telegraph, and the confusion and incorrectness of messages. It is a rare thing for a foreign telegram to arrive correctly. Even inland messages have words omitted or words inserted which were not given in for transmission. A telegraph clerk in the London central station throws light on the system, which causes the complained-of delays. If, for instance, a repetition is required by the clerk at the central station, or a word has to be queried, the greatest difficulty is experienced. Not infrequently the query has to be sent round by another wire to an office in the same vicinity and carried to the offending office by messenger, the telegram waiting for correction all the time." Possibly the new postmaster-general, Mr. Chamberlain, will change this condition of affairs.

TIME-LIMIT CIRCUIT-BREAKER.—Mr. Henry M. Hobart, of Berlin, Germany, has patented, in this country, a time-limit circuit-breaker, under an application filed in January, 1901. As is well known, in many cases it is desirable that circuit-breaking devices should not operate on heavy loads of only a few seconds or a fraction of a second duration. His invention consists of a circuit-breaker so arranged as to respond to an overload only after the overload has lasted a predetermined time. To accomplish this mode of operation, he arranges the tripping-coil of the circuit-breaker in a divided circuit, the branches of which are of different time constants and are connected to the circuit upon which the circuit-breaker operates. In the branch containing the tripping-coil is placed a device which serves to retard the growth of current in this branch when the current in the main circuit varies. The other branch of the divided circuit is formed so as to offer no impediment either to the growth or decay of rapidly-varying currents. The result of this plan is that when the current in the main circuit suddenly increases, the portion of the same passing through the tripping-coil increases but slowly, while that in the branch circuit about the tripping-coil rises instantly to its full value. Unless the main current is maintained for a predetermined interval, for which the parts are proportioned, the circuit-breaker will fail to act, the main current returning to a value or values below that for which the circuit-breaker is set. In case, however, the overload current lasts a length of time sufficient to allow the current in the tripping-coil branch to rise to a steady value the circuit-breaker will then operate.

COMPENSATED ALTERNATORS.—A patent has been issued to Mr. Henry G. Reist, on improvements in "compensated alternators," or alternating-current generator the field of which is supplied with direct current from a synchronously-driven exciter. The voltage of the exciter is automatically controlled by passing current derived from the main alternator through the armature of the exciter, thereby varying the armature reaction of the exciter, which in turn varies the field strength and regulates the voltage. The alternating current is fed to the exciter in such a manner as to produce in the armature-winding a rotating magnetic field, moving with respect to the armature in a direction opposite from the direction of rotation of the armature. As the exciter-armature moves forward with the same speed with which the rotary field therein moves backward, the field as a consequence remains stationary in space as long as the power factor of the load remains constant. To secure the necessary initial adjustments of this field with respect to the field-magnets upon which in practical operation it reacts, Mr. Reist devised a structure in which the field-magnets of the exciter are mounted so that they may be angularly displaced, thereby adjusting the angle at which the armature-flux is permitted to act upon the field. Another feature of his arrangement consists in bridging over the field-poles of the exciter by a band of magnetic material, which by reason of saturation does not allow an undue short-circuiting of the field-flux. He finds that the presence of this bridge makes the compounding more regular. Mr. Reist has also introduced other features of novelty and advantage, which have now become more or less familiar in this class of apparatus, in which his own work follows up that of Mr. E. W. Rice, Jr.

MARCONI SHIP MESSAGES.—A scheme has been promulgated at Liverpool to establish a post office and signal station, not in mid-ocean, but 110 miles west of the Lizard, a place where, for British commerce at least, information from the shore is more valuable than it would be further out at sea. The purpose is to moor there a ship equipped with a powerful searchlight and the Marconi apparatus. The water at that point is 70 fathoms deep, and to overcome the tendency of a mooring chain as long as that to pull down the bows of the ship in heavy weather, the chain is to enter through a hawse pipe in the bottom of the hull at the heel of the foremast, so that the weight may be distributed evenly along the whole keel. With her light illuminating the clouds this vessel will be easily "picked up," even at night, from a distance of 60 miles, and, situated right in the fairway of the Channel, it is expected that great advantage will be derived from the distribution of orders sent from shore by owners for vessels passing in or out. For instance, a ship from the south or west, on reaching this station, could be directed to proceed up either the English, Bristol or St. George's Channel, without delay, thus avoiding pilotage and port dues, to say nothing of waste of time, and, in winter, danger in making the land and entering and leaving port. As a reporting station to be approached in any state of the weather, for the purpose of transmitting important information, the value of the floating post office will be large, while as a salving station, lying as she will at the junction of the three great streams of British and Continental traffic, she should have many opportunities of rendering assistance, especially as her boat, designed primarily to pick up bottles or bags of letters dropped by passing vessels, will be so constructed as to withstand the roughest seas. The terms on which these diverse services will be rendered have not yet been announced, but, of course, they will all cost money, as the enterprise is a private one, and not governmental, as some may think it should be.

TELEPHONY IN PARIS.—A cable dispatch from Paris says: The Parisian telephone girl has received a shock. She will no longer be permitted to interrupt conversations by switching people on some one else. An order has gone forth that no interruption shall take place until the person using the apparatus gives a signal that the conversation is ended.

LIGHTNING STROKES seem to have been unusually numerous this year, but the Weather Bureau has issued a bulletin which tends to prove that the danger to life from lightning is really very small. It covers the observations of eleven years, during which period every reported case of death or physical injury from lightning has been investigated. The statistical average is 2.53 deaths for each area unit of 10,000 square miles. Probably no other cause of death admitting of statistical classification would show so low a mortality record. Taking the figures for one year, 1900, they are less reassuring. In the United States 713 people were killed or received fatal injuries from lightning. The number of those more or less seriously, but not fatally, injured by lightning during the year was 973. Of the total number of 1,686 killed or injured in 1900, the number in houses or barns at the time of the accident was 593. Roughly, the number killed or injured in this one year was about 4.45 to each 10,000 of population; but the man who is struck has no use for averages.

THE TESTING OF THERMOSTATS.—Mr. T. M. Heaphy, whose name is well known in connection with electricity in its relation to fire insurance rules in England, has just been granted, here, a patent on means for testing thermostats for fire purposes, or in incubators, etc. At present the indicator circuits of thermostats are easily tested to prove that they are in working condition when not closed by the thermostat-contacts; but there is a difficulty in testing them to prove that the circuits will be closed and the alarm given by a rise of temperature in the thermostat itself. This difficulty is so great that the thermostats are seldom or never tested as thermostats after being installed. This is a great disadvantage, as the thermostats may get out of working order and not be able to give the alarm or signal when required. For example, a mercury thermostat may fail through the mercury not being able to close the thermostat-circuits, owing to the glass tube or bulb being broken, or the thermostat may get injured either accidentally or maliciously or get so out of order that it cannot act at all when the requisite rise in temperature takes place, caused by a fire, and yet the present tests might indicate that the alarm or signaling-bell and indicator-circuits were in perfect condition, and so cause a feeling of false security to be engendered, and the building containing the thermostats be from a fire-risk point of view in a worse condition than if thermostats had not been used, as watchmen and other precautions might have been in consequence dispensed with. In any case the defect in the thermostat may not be detected, owing to there being no proper way of testing it. It is obvious that the consequences of this inability to test the thermostat may be very serious. To remove this difficulty, Mr. Heaphy heats the thermostat artificially by an electric current from any convenient source, passing through a suitable resistance close to or in contact with the thermostat. This produces the same effects so far as the thermostat is concerned as a rise of temperature in the air surrounding the thermostat (or as a rise of temperature in the room or place in which the thermostat is situated), due to a natural or other cause, which rise of temperature when it has reached a given amount the thermostat is intended to indicate. It, therefore, tests not only the thermostat itself, but all the electric circuits and any mechanism connected with or controlled by the thermostat.

LETTERS TO THE EDITORS.

Graphical Calculation of Synchronous Motors.

To the Editors of Electrical World and Engineer:

Sirs.—I read with much interest, in your issue of May 19, 1902, the very clear and able article by Prof. F. G. Baum on the graphical calculation of synchronous motors. I may be permitted to say that this method and the corresponding diagram (p. 861, Fig. 2) are identical with those published by me some years ago in the first edition of my little book, "Moteurs Synchrones" (1896). The same diagram is employed throughout the second and enlarged edition of the same book (published by Gauthier-Villars at the end of the year 1900), and which you honored with an able and friendly review in one of your numbers of 1900—for which I take advantage of this opportunity to offer my thanks. In this second edition I carried the theory somewhat further by taking in account the effect of saturation of the fields, which is neglected in the ordinary theories as well as in the single diagram alluded to. Moreover, in another paper presented to the Electrical Congress of 1900, and published in the middle of 1901 in *L'Eclairage Electrique,* I extended the same theory to rotary converters, of which I gave the first purely graphical treatment.

It is very gratifying to me to see that these methods are now finding favor and receiving practical development in the hands of able American engineers, and I hope that in the future their clearness and simplicity in comparison with the purely mathematical treatment will help many students to grasp at once consequences which are otherwise difficult to understand. I am grateful to them for perusing my publications on these subjects.

PARIS, FRANCE. A. BLONDEL.

Theories of Hertzian Waves.

To the Edtors of Electrical World and Engineer:

Sirs.—For a brief, popular summation of the knowledge held today of the field of force in wireless telegraphy, the editorial appearing in a recent issue of ELECTRICAL WORLD AND ENGINEER leaves little to be desired. The explanation there given of the probable means of propagation of electric force is as elegant in expression as it is clear and succinct. In this day of diagrams and cold mathematics it is refreshing to think of "invisible cobwebs of electric lines in warp and magnetic lines in woof"—an analogy as apt as it is poetic. With such elements in our philosophy there seems no time for quibblings over nomenclature or harsh feelings as to definition. Truth is the object of search, and it is of far too noble dignity to trifle with.

If we speak simply of *"waves,"* electromagnetic waves, following the constant example of Mr. Heaviside, whether these be "free" or "guided" waves, we shall, perhaps, avoid any confusion of terms. Certainly the electrical engineer has not yet appropriated this term for alternating currents generally.

There are certain statements appearing in Mr. Collins's contribution to the subject under discussion with which I cannot agree. It has been proven repeatedly by various investigators of admitted skill that salt water is highly opaque to electric waves—its opacity depending on the wave length of the vibration. A coherer placed within a block of damp cement is found to be completely protected from Hertzian waves. Even with a wire laid along the bottom of a lake to guide the waves, and directly connected to a coherer, Prof. Fleming was unable to transmit an impulse from a spark through the water. In his admirable letters on this subject, appearing last year in the London *Electrician,* he points out that substances containing the hydroxyl molecule ($H\ O$) or $N\ O_2$ are opaque to waves of a few inches long or longer, although dry ice ($H_2\ O_3$) is an exception. Substances following Maxwell's law are transparent to these waves. His lucid explanation of the anomalous action of water in this connection and of its "quasi conductivity" will correct the impression that "salt water conducts only by electric action" at these high frequencies. For this idea we are by no means indebted to Monsieur Guarini Foresio!

In view of what European physicists have established, Mr. Collins's experiment across the Schuylkill River affords simply illustration that the Hertzian waves very easily cease to be free etheric vibrations, but become sliding or guided waves. As well assert that sound heard in the free air in one basement from the other traveled through the intervening earth and water as that the electric waves did so.

The idea of grounding transmitting and receiving antennæ to effect resonance there-between is, so far as I know, novel. Resonance with dead beat vibrations is simply a contradiction of terms. Grounding an upright conductor makes it as nearly dead-beat as it is possible to do. A 50-foot simple antenna operates better with a 30-foot upright than does one of less height; a 75-foot antenna will answer better yet—the longer the better. "The

reason is simplicity itself"—there is here no resonance possible, properly so termed. Lodge, the authority quoted, Marconi, Braun, Blondel, have all pointed out this principle that the grounded system is rapidly damped, its resonance poor, or nil. Braun seeks to free his from the ground for this very reason, as Mr. Collins himself very naively points out. The capacity between earth and antenna is not always the same; is not necessarily large. It follows a simple mathematical law.

The "adherents of other dogmas" and "pseudo-hypotheses" referred to (among whom may be humbly enumerated Lecher, Blondel, S. P. Thompson, Abraham) may not be altogether ignorant of the "simplest law of optics," but I am not sufficiently familiar with rectilinear propagation of light around a corner to admit the analogous explanation of the guided electric wave's ability to accomplish this gymnastic feat—for a quadrant of the earth's circumference; neither is it clear why diffused particles in the upper atmosphere, of dimensions comparable only with those of light waves, should seriously reflect vibrations of a million times that wave length. Moreover, experiments with balloons in the upper atmosphere, such as I mentioned in your columns, July 5th, seem to prove very clearly that the field of force is confined quite closely to the earth's surface.

In "getting wireless telegraphy out of its swaddling clothes" let us incidentally acquaint ourselves with known optical laws, and if we find that we cannot entirely explain the action of a solenoid by comparing it with a searchlight, hesitate before we fetter any theory on unsuspecting posterity, "for whatever time the existing theory of light shall prevail, or as long as the electromagnetic theory endures, and to the finality of belief!"

Jersey City, N. J. Lee de Forest.

DIGEST
of
Current Electrical Literature.

Dynamos, Motors and Transformers.

Direct-Current Dynamo.—Nowak.—An illustrated description of a 650-kw, 500-volt, direct-current dynamo. The number of poles is 30, the number of revolutions 90, the armature diameter 5,000 mm., the armature length 210 mm. As it was desired not to have a separate flywheel, this large armature diameter was chosen, in order to put into the armature the total momentum required to obtain a good degree of uniformity of speed in one revolution. The details of the construction are described and illustrated.—*Elek. Zeit.*, July 17.

Power.

Electric Mine Draining Plant.—A very well illustrated description of an electric generating installation for working a draining pump, exhibited by Lahmeyer & Co., at the Dusseldorf exposition. The primary installation generates 2,000-volt, three-phase currents, the capacity being 750 kw. The dynamo is excited by a three-phase, direct-current converter, which is supplied with current from the dynamo. The exciting current at starting is given by a storage battery; this is recharged by the converter when the engine is working. The underground pump motor is a 650-hp machine, keyed direct on the pump shaft. The speed is 60 r. p. m.—Lond. *Eng'ing*, July 11.

Power Transmission in New Zealand.—Haes.—The first part of a paper on an electric power transmission plant at Rotorua, in New Zealand. The power house is at a distance of 13 miles from Rotorua. The single-phase, alternating-current system is used. Current is generated at 4,000 volts, about 1,000 volts are lost on the line, and in the city the voltage is reduced from 3,000 to 100. The power house contains two 100-hp turbines, driving two 50-kw alternators of the Mordey inductor type.—Lond. *Elec. Rev.*, July 11.

REFERENCES.

Electricity in Mining.—Clarke.—An illustrated article in which he first describes several three-phase installations in American mines. He then discusses briefly the different uses to which electric power is put in mines, as for pumping, hoisting, coal cutting, drilling and ventilation.—*Cassier's Mag.*, July.

Mining Elevators.—Koettgen.—A long abstract, with a series of diagrams, of a paper on the methods of starting electric lifting machines for mines.—*Glueckauf*, July 5.

Ventilators.—Percy.—A well-illustrated article on colliery ventilating machinery.—*Cassier's Mag.*, July.

Vertically-Driven Generators.—Perkins.—Some illustrated notes on vertical shaft turbine generators in various European power plants.—*Sc. Am. Sup.*, July 19.

Canadian Water-Power Plant.—Perkins.—An illustrated description of the hydroelectric power plant at Shawinigan Falls on the St. Maurice River, near Quebec.—*Elec. Rev.*, July 26.

Traction.

Main-Line Railway Traction—C. T. Child.—A general discussion of electrical problems of main-line railway traction. Direct current would not do. Alternating-current transmission and converter substations he considers as a "make-shift." A true alternating-current system has the disadvantage of the low power factor and unsatisfactory speed regulation of induction motors, and difficulties in the construction of the feeding system. The third rail is looked upon as a temporary device which may survive for a time on absolutely restricted rights of way, but is impracticable on a main-line right of way. A system in which alternating current is taken from the line of conductors and converted into direct current by a substation on the train to feed the direct-current motors, "while very interesting, would be more satisfactory to railway engineers if it had been tried long enough to give date of costs of operation and maintenance, and, above all, of certainty of operation." The first place for electrical equipment on main lines is on suburban sections, for the handling of heavy passenger traffic. The introduction of electric traction on main lines is still considered to be far off, unless the induction motor can be brought under more perfect control.—*Eng. Mag.*, August.

Electric Locomotives for Mine Haulage.—Gibbs.—An article on the modern practice and the economies of electric mine locomotives. He reaches the following conclusions. Small mines should use the simplest possible system, both for power plant and wiring; for these he recommends a direct-current generator and the distribution of current at 250 volts pressure. The power system in extensive mining plants should be planned like any other large distribution scheme; by the use of a combined alternating, direct-current system all the advantages of simple alternating motors for auxiliary uses, economical high-tension distributing, and a low and safe direct-current locomotive haulage system, may be obtained, thus rounding out a complete modern power system for all the principal mine operations. The average saving to be expected by the adoption of electric instead of mule haulage is from 4 to 5 cents per ton of output, and in large mines with heavy grades the saving is frequently as great as 8 cents per ton.—*Cassier's* Mag., July.

REFERENCES.

Mechanical Engineering of an Electric Railway.—Quick.—An illustrated article in which he discusses in detail the mechanical problems met and methods used in the operation of a road, the relations of the various departments to one another and the scope of their work, and in particular that of the mechanical departments.—*Eng. Mag.*, July.

Battery for Traction.—An illustrated description of the stationary storage battery and booster equipment of the Chicago City Railway.—*West. Elec.*, July 5.

Telpherage.—Clark.—An illustrated paper, read before the Civil Eng. Club of Cleveland, in which he discusses various details of construction in telpherage.—*Jour. Ass. Eng. Soc.*, June.

Installations, Systems and Appliances.

Electric Installation of an Apartment House.—A. L. Rice.—A very long and well-illustrated description of the power plant of a

large apartment house in New York. There are 18,000 electric lamps. Each apartment has a telephone. The elevators are hydraulic, the seven dumb waiters electrically driven and automatically controlled by a push-button system from any floor; the lift being about 200 feet. There is a complete system of ventilation provided. Air, tempered to 70° F., is supplied by two 140-inch blowers, each driven by a 30-hp motor. Each apartment is provided with a panel box; each has a meter and circuit breaker, and a separate feeder is installed for the current for electric cooking. The wiring is done in concealed enameled conduits, which for the risers are run in vertical boxes, and for the horizontals are placed between floor and ceiling, with only four quarter bends allowed between pull boxes. The arrangement is such that all current can be taken from the street supply or from the generating plant, the change being made by double-throw switches and bus-bars on the switchboard. The lamps are supplied from a three-wire system; the motors for elevators, blowers, etc., from a two-wire system. A storage battery operates in parallel with the generators on the three-wire system. There are five generating sets; three of 250-kw, and two of 125-kw capacity.—*The Eng.*, August 1.

REFERENCE.

Two and Three-Wire Systems.—SNELL.—His Mun. Elec. Ass. paper in full, on the relative advantages of two and three-wire distribution, an abstract of which was noticed recently in the Digest.—Lond. *Elec. Eng.*, July 25.

WIRES, WIRING AND CONDUITS.

Self-Induction and Capacity in Transmission Lines.—BAILLIE.—The first part of an article, in which he considers to what extent self-induction and capacity should be taken into account in practical work. He gives a collection of formulæ, applicable to the different systems of transmission, and in accordance with slide-rule requirements. He first discusses self-induction and deals with single-phase, three-phase and two-phase, both with four and five wires. He gives formulæ for the value of the self-induction of parallel wires; also diagrams with a curve for the self-induction between two parallel wires as a function of the ratio of their distance to their diameter; and curves for the drop of pressure due to self-induction in percentage of the resistance drop, for various diameters and for various distances between the wires. On lighting circuits the effect of self-induction is negligible; in the secondary the power factor is unity, and in the primary, though the excitation of the transformers can produce a large lag at low loads if no transformers be cut out of circuit, yet the high-tension mains are comparatively small, and so have a negligible self-induction drop. As an extreme case may be cited one of the St. Petersburg lighting companies, where the power factor of the primary is as low as 0.53 at low loads; but even then the presence of a self-induction drop would tend to assist regulation rather than hinder it. But on power circuits, which supply induction motors, the case is very different. A 100-hp induction motor of the General Electric Company had a power factor varying from 0.43 at quarter load to 0.76 at full load, and though by use of a very small air gap the full load power factor may be increased to 0.9, yet a power factor of 0.7 is not too low an average to assume on a power circuit; the figures given above for the self-induction drop are then applicable, and show that both in overhead lines and cables the self-induction calls for some attention. Of course, on power circuits good regulation is not so important as on lighting circuits, but this fact is generally discounted by allowing a larger drop in the line. The article is to be concluded.—Lond. *Elec.*, July 18.

Protection of Machines.—CLARKE.—A brief article, illustrated by diagrams. While it is often said that every circuit should be protected by a fuse or automatic device, this rule does not apply where a three-wire system is balanced by means of a motor generator. The balancer is a very necessary machine, and is not in any case to be cut out of circuit while the generators are supplying current to the outers. When the balancer fails to perform its function, unless other means of balancing are available, the generating station should be shut down immediately. Consequently, no risk should be incurred by inserting fuses or cut-outs in circuit, but reliance should be placed on a good high-grade machine.—Lond. *Elec. Rev.*, July 11.

ELECTRO-PHYSICS AND MAGNETISM.

Radioactivity.—RUTHERFORD AND BROOKS.—A comparison of the radiations from radioactive substances. Both uranium and radium emit negatively charged particles with high velocities, similar in all respects to cathode rays. In addition, uranium, radium and thorium emit rays non-deviable by a magnetic field, which are readily absorbed by gases and thin layers of metal. These non-deflectable rays differ from one another in penetrating power, and cannot consequently be ascribed to any radioactive impurity common to all these substances. In addition, thorium and radium possess the remarkable property of continuously emitting radioactive emanations which behave in all respects like radioactive gases. The emanation from thorium and radium differ greatly in their rates of decay of radiating power. The presence of an emanation gives rise to the complicated phenomenon of "excited" radioactivity. The non-deviable "excited" radiations due to thorium and radium, although apparently of the same penetrating power, decay at very different rates. "Excited" radioactivity is not confined to radium and thorium, for Elster and Geitel have recently shown that a negatively charged wire, exposed in the open air, free from all possible contamination by radioactive substances in the laboratory, becomes strongly radioactive. This excited radioactivity decays at a different rate from that due to the emanations of thorium and radium, and is also of greater generating power.—*Phil. Mag.*, July.

Electric Resonance for Light Waves.—WOOD.—A brief abstract of a (Brit.) Phys. Soc'y paper, " on the electrical resonance of metal particles for light waves." In a previous paper he had shown that granular deposits of the alkali metals exhibit brilliant color by transmitted light; these colors were referred provisionally to the electric resonance of the minute particles for light waves. The present paper gives an account of experiments made with gold and silver films to determine whether the resonance is molecular, or whether it is an electrical vibration of metallic masses, smaller than the light waves, though of the same order of magnitude. Further investigations on the dispersion of the films and a more careful study with polarized light will doubtless throw light on the matter.—Lond. *Elec.*, July 11.

Discharge Between Flames.—SEMENOW.—An account of his continued researches on the discharge between and through flames. He compares a straight flame with a pointed conductor, whose density of charge is, of course, greatest at the point. In the case of a flame, the charge produces a diminution of pressure within the flame. When the distance between two flames is too great to allow of the passage of a spark, brushes appear at both flames, but in the case of the positive flame the brush is attached to it by means of a luminous thread 1 cm. in length. When the flames are brought closer together the brushes are converted into a spark, and he finds that the current of air accompanying the positive brush contracts and forms the spark. There is no sudden transition of one form of discharge into another; "*for* if a point wheel is substituted for the positive flame, its velocity of rotation diminishes steadily as the distance diminishes, and the brushes gives way to the spark." The spark, then, "consists of a positive air current and positive metallic ions." He further proves that the negative air current proceeds in the opposite direction, and surrounds the spark like a sheath.—*Comptes Rendus*,—June 16; abstracted in Lond. *Elec.*, July 4.

Ionized Vapors.—CAMPANILE AND DI CIOMMO.—An account of experiments, in which they found that ionized air, on being mixed with the vapor of a volatile liquid, undergoes a change of conductivity; in every case there is an increase of conductivity, which is somewhat in accordance with the volatility of the liquid.—*Phys. Zeit.*, June 1; abstracted in Lond. *Elec.*, June 4.

Period of Zodiacal Light.—DECOMBE.—A paper in which he advances a new hypothesis of the 11-year period of sun spots and of the zodiacal light. He considers that these periodic variations are of an electromagnetic character, and are propagated through what he regards as the residue of a flat solar nebula which extends far beyond the earth's orbit. The variations will die out in course of time, but will persist, and have persisted, very long on account of the very slight damping they undergo. If they obey the ordinary laws of the vibrations of free plates, the sun must be at a ventral segment, and the circumference may be regarded as a nodal line.—*Comptes Rendus*, June 9; abstracted in Lond. *Elec.*, July 4.

Zeeman Effect.—RUNGE.—An article on curious regular relations which he has found by studying the Zeeman effect. We know from the work of Paschen, Runge, Kayser and Rydberg that every spectrum may be split up into "series" of lines obeying certain laws. It is usual to distinguish a main series and two subsidiary series.

In addition, there are "doublet" series—*i. e.*, a series for each component of a set of doublets—and "triplet" series, resulting from the arrangement of all the first, second or third lines of a set of triplets in series. This series system has received a striking confirmation from the Zeeman effect. The author finds, first, that lines belonging to the same series are split up in an exactly similar manner, the difference of frequency produced being the same in each case; and he finds, secondly, that in different elements, lines of the "corresponding" series are split up in the same manner. Moreover there is a simple numerical connection between the differences of frequency produced in the components of triplets and doublets.—*Phys. Zeit.*, July 1; asbtracted in Lond. *Elec.*, July 18.

ELECTRO-CHEMISTRY AND BATTERIES.

Atomic Weights.—VINCENT.—A paper in which he brings forward a new numerical relation between the atomic weights of the elements. It states that the atomic weight is the 1.21st power of N, when N is the number of the element in an ascending series, and is always a whole number. Hydrogen is, of course, No. 1. There are, however, certain gaps in the series which the author allocates to elements yet to be discovered. The greatest deviation from the rule is shown by iodine, whose atomic weight comes out wrong by 3.9 units. But he shows that this may be due to a wrong serial number assigned to it. If it changed places with tellurium, not only would the error be much less, but the periodic law would be much better observed.—*Phil. Mag.*, July; abstracted in Lond. *Elec.*, July 11.

Gaseous Electrolytes.—HAGENBACH.—An account of experiments showing that gases are capable of dissolving and ionizing salts. He made up a cell of platinum and copper electrodes, with a solution of rubidium iodide in liquid sulphurous anhydride. *Rb I* was chosen on account of its great solubility and conductivity when dissolved. He measured the resistance and e. m. f. of the cell at temperatures ranging from 26° to 157° C. At the latter point, which lies above the critical temperature, the cell acquired a resistance of 500,000 ohms, but the e. m. f. was not sensibly affected, being about 0.1 volt, as against 0.07 volt at 26 degrees and 0.12 volt at 100 degrees. The copper electrode was oxidized and formed iodide of copper. The experiment shows that a gas is capable of ionizing a salt held in solution; at the same time, the chances of recombination are so much more numerous in a gas than in a liquid that the number of free ions is kept small. Hence the low conductivity of gaseous electrolytes.—*Ann. d. Phys.*, No. 7; abstracted in Lond. *Elec.*, July 4.

Gold Process.—HAMMOND.—An illustrated article, in which he discusses in general the conditions of gold mining in the Transvaal. Concerning the Siemens & Halske process, he says that its cost is slightly greater than that of zinc precipitation, and the percentage of extraction is about the same. But the Siemens & Halske process may be applied to any solution, weak or strong. The voltage used is 2 or 3; the current density about 0.06 ampere per square foot of cathode. Once a month the lead sheets are removed and replaced, and the gold-coated lead is melted and cupelled, yielding a bullion of 0.880 fine in gold, and 0.100 in silver.—*Cassier's Mag.*, July.

REFERENCES.

Laboratory Furnace.—An illustrated translation in abstract of Heraeus' article on a new form of laboratory resistance furnace with a spiral of platinum foil, as was recently noticed in the Digest. —Lond. *Elec.*, July 18.

Dry Cell.—An article giving rules for making a dry cell.—*English Mechanic; Sc. Am., Sup.*, July 5.

Dusseldorf Exposition.—An article on stationary and automobile storage batteries, exhibited by the Neumuehl Lead Works of Morian & Co.—*Centralblatt f. Accum.*, July 15.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Nomenclature.—STRECKER.—A paper read before the Berlin Electrical Society, in which he gives the report of a special committee on uniform nomenclature. The basis of the nomenclature proposed is the table recommended by the Chicago Electrical Congress in 1893 (see ELECTRICAL WORLD AND ENGINEER, Jan. 5, 1901, page 50), but while the latter contains only 37 quantities, the new table proposed contains 53. The magnetic quantities in the Chicago Congress table are designated by letters which are variously denoted as "French script" in this country, "German script" in France, and "round script" in Germany. In the present table the regular German capital letters are used in the place of these, and although they are considered to be the same by the author, there is, as a fact, considerable difference. It is proposed to represent not only the magnetic quantities by these letters, but also the heat quantities. The following symbols are new: number of turns N, frequency n, radius R, r, number of revolutions d, work A, efficiency h, specific gravity or density δ (Greek letter), temperature $\mathfrak{T}$, $\mathfrak{t}$ (German letters), heat quantity $\mathfrak{Q}$ (German letter), magnetic quantity $\mathfrak{m}$ (German letter), magnetic reluctance $\mathfrak{W}$ (German letter), coefficient of magnetic hysteresis η (Greek letter), electric resistance W, w, dielectric constant ϑ (Greek letter), electrochemical equivalent a (Greek letter), eddy current constant β (Greek letter). It is proposed to use L both for the coefficient of self-induction and for the coefficient of mutual induction, but to distinguish them by the indices s and m. Whenever in an article or paper this nomenclature is used, it is suggested to indicate this by a simple sign placed at the head of the article; for this it is proposed to use the sign ※. This system is offered as a suggestion, and the electrical engineers of all countries are invited to discuss it.—*Elek. Zeit.*, June 5.

Testing Meters.—DAWSON.—An article in which he discusses the "short-time' test for several meters; it consists in the passing of a steady current at the usual proportions of full load, noting the time taken to cause one revolution of the spindle, or *vice versa*, noting the revolutions of the spindle in a certain time, and from this ascertaining the actual constant K of the meter, then comparing with the testing or required K and deducing the percentage error. The testing K has a different meaning with different types of meters. In the Chamberlain & Hookham meter it is the time in seconds that 1 ampere will take to cause the armature spindle to make one complete revolution. In the Ferranti meter it is the number of revolutions of spindle per ampere per minute and depends upon the ratio wheels. In the Thomson watt-hour meter it is the number of watt-hours recorded by one revolution of the armature spindle. The rules and formulas for the tests in the case of these three meters are given.—Lond. *Elec. Rev.*, July 25.

Unifilar Magnetometer.—SCHULZE.—A paper in which he discusses the comparative value of the bifilar and unifilar suspension of a magnetometer needle, in view of the fact that the latter type is now the most popular in terrestrial magnetic observations. He shows that if, with a unifilar suspension, the needle is twisted out of the magnetic meridian into a new position of equilibrium, the oscillations about the new zero are unsymmetrical, the greater elongations being on the side towards which the twist has taken place. In ordinary operations the deflections are of greater importance than the oscillations, but the author shows that a similar lack of symmetry is shown in the deflections produced by equal couples. The errors thus introduced may easily be of practical importance, as is shown by a simple calculation. He gives an equation by means of which the true scale values may be calculated for positions near the zero, and also a method of correcting the readings for considerable deflections. These corrections have hitherto been neglected in magnetic observations.—*Ann. d. Phys.*, No. 7; abstracted in Lond. *Elec.*, July 18.

Induction Coil.—IVES.—The conclusion of his illustrated paper. He discusses the problem of how much capacity must be put around the break to stop the sparking at the break. He gives a formula for the "optimum" capacity, that is, that value of the capacity which gives the greatest difference of potential in the secondary. This formula shows that the optimum capacity is directly proportional to the steady current and inversely proportional to the velocity of breaking, and to the dielectric constant. This appears to indicate that for the same current and the same dielectric the optimum capacity depends only upon the rate of breaking of the primary circuit. The velocity which, according to his theory, is both necessary and sufficient, in order that there shall be no sparking, is called the safe velocity. According to his theory, when the speed of breaking is increased, without a change of the capacity, the secondary potential should increase up to a certain point and then remain constant. He has examined these theoretical results by experiment, but the results obtained were not very definite. They show a tendency towards a decrease in the secondary potential as the velocity of breaking is decreased, but do not, as a rule, show any well marked value of the velocity above which the potential remains constant. The experiments were made with three different kinds of

breaks, called by him the guillotine break, the free-fall break, and the rotating break.—*Phys. Rev.*, July.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—Gray.—A paper read before the Engineers' Club, of Philadelphia. He gives a brief historical review and a general statement of the chief methods used at present in wireless telegraphy. He refers briefly to the Fessenden system, as follows: "The sensitive part of his receiver is a continuous conductor and does not depend for its operation, like the coherer, on a vast number of loose contacts. Each time the electrical oscillation passes along the circuit in which the Fessenden receiver is placed, a change occurs in the electrical condition of the circuit. This change of condition manifests itself as a click in the telephone receiver. One click is produced each time a complete oscillation passes along the wire; or, in other words, each time the secondary spark occurs at the sending station. If these interruptions are slow, the clicks are difficult to interpret. As the number of interruptions increase, the individual clicks form themselves into more or less of a buzzing sound; and if the interruptions are made with a tuning fork, for instance, the telephone receiver will produce the same tone as the sending mechanism gives out. It will be seen that this arrangement lends itself, with slight modifications, to a telephone system." The chief advantages of the Fessenden system are said to be the simplicity of circuits and the fact that there are none of the fine adjustments necessary that are required in the coherer system. The Fessenden receiver is said to have between 20 and 25 times the sensibility of the former receivers. His system is also said to be admirably adapted to syntonic methods.—*Proc. Eng. Club, Phila.*, July. (Professor Fessenden has had a series of United States patents issued to him on his system, under date of August 12.—Eds. E. W. & E.)

Telephone Vibrations.—Kempf-Hartmann.—An account of the results of a long investigation of the vibration of telephone membranes. He recorded the vibrations of a telephone diaphragm by means of a mirror stuck onto it, and a device consisting of an arc light, a point diaphragm, a system of lenses and a revolving cylinder containing a sensitive film. The first point investigated was whether a note received by the diaphragm gives rise to a corresponding series of vibrations of the diaphragm at once, or whether the vibration only gradually fell in with that of the air. The photographic traces of a tuning fork note show that the reaction is practically instantaneous, the "period of latency" not exceeding 0.0005 second. The maximum amplitude is attained as soon as two full periods have passed through. After that the curve for a constant sound remains remarkably constant. When the note ceases, the proper vibration of the diaphragm persists long enough to be seen and even heard, but it is greatly damped by a rubber plug attached to the center of the diaphragm. It also appears that the overtones which produce the rattling and clattering noises in the telephone are the more prominent the greater the force with which the note is sounded. The records show a sound whenever a sound is heard, and *vice versa*. In traces of complete words, however, the records show a number of details which are quite beyond the perception of the ear. He gives some interesting curves representing vowels and consonants, which are reproduced in the finest details.—*Ann. d. Phys.*, No. 7; abstracted in Lond. *Elec.*, July 11.

Miscellaneous.

Electricity and Plant Growth.—Plowman.—An account of some experiments made at the Harvard Botanic Gardens. They have been of a widely varied nature, dealing with both static and kinetic charges, through a range of potential from 0.5 to 500 volts. Either platinum or high-grade carbon was used for the electrodes, and special care was taken to insure normal conditions of temperature, light and moisture. The results appear to show that vegetable protoplasm is paralyzed and quickly killed by the conditions existing about the anode, while within certain fairly broad limits it is stimulated by the conditions about the cathode. For instance, seeds placed near the anode are always killed by "current amounting to 0.003 ampere or more," if continued for 20 hours or longer, while seeds placed near the cathode have in most cases been but little affected, and under some conditions have been apparently stimulated by such currents. He tries to explain his observations by a provisional theory, in which he assumes "certain relations of plant growth to ionization of the soil." He thinks the effects are produced by the electrical charges of the ions, rather than by any mere chemical activity of the atoms. He makes some peculiar assumptions; for instance, he says that "since the movements of ions in solutions are relatively slow it is reasonable to suppose that in the region of the anodes there would be slight excess of positive ions, due to the rapid neutralization of the negative ions by the positively charged electrode" (This disagrees with modern views, according to which at any place inside of an electrolyte there are always the same number of positive and negative ions).—*Am. Jour. Sc.*, August.

References.

Lightning Flash.—A communication, with diagram, on "a remarkable lightning flash," which did damage to an electric line.—Lond. *Elec.*, July 11.

Dusseldorf Exposition.—The first part of a well-illustrated description of machines and apparatus exhibited by Lahmeyer & Co.—Lond. *Elec. Rev.*, July 11.

New Books.

Books Received.

Diagrams and Complete Information for Telegraph Engineers and Students. By Willis H. Jones. New York: *Telegraph Age*. 260 pages, 126 illustrations. Price, $1.50.

Self-Propelled Vehicles.—A Practical Treatise on the Theory, Construction, Operation, Care and Management of all Forms of Automobiles. By James E. Homans, A. M. New York: Theo. Audel & Company. 632 pages, 466 illustrations. Price, $5.00.

Position of Electrical Engineer.

The New York Municipal Civil Service Commission has issued notice that an examination for electrical engineer will be held on Friday, August 29, at 10 A. M. The data given is as follows: The receipt of applications for this examination will close on Monday, August 25, at 4 P. M. The scope of the examination will be as follows:

Subjects and Weights.—Technical knowledge, 6; experience, 2; handwriting, 1; arithmetic, 1.

Candidates who obtain a place upon the eligible list as a result of this examination will be certified to any department of the city employing persons requiring the experience and knowledge of an electrical engineer, at a salary of $3,000, or more, per annum (sixteenth grade).

There is at present a vacancy existing in the Fire Department under the title of "Superintendent of Telegraph." The compensation attached to this position is $3,000 per annum.

Applicants should possess the education of an electrical engineer, and should have had practical experience in the construction and management of fire-alarm telegraph or telephone circuits, including the construction of subways, character of cables and telegraphic lines, planning and making of circuits, and of the extension of lines and electrical connections incident thereto; making estimates, specifications and calculations of the cost of construction of subways, ducts, cables, etc., and should have had experience in handling men.

The Manufacture of an Incandescent Lamp.

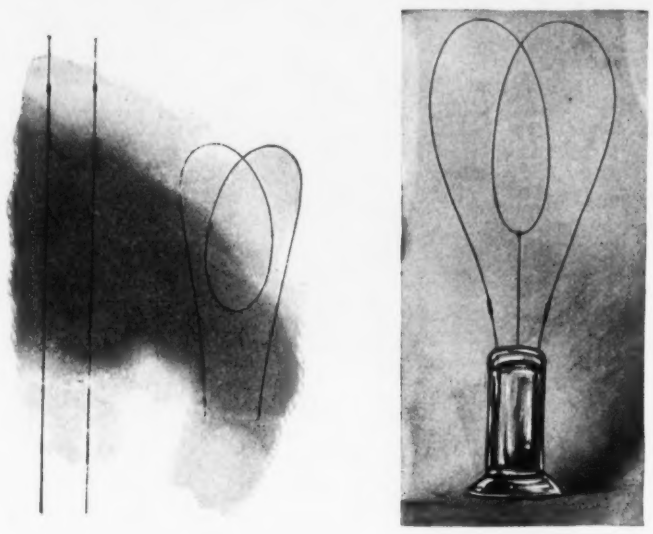
The various processes involved in the manufacture of incandescent lamps have for the most part been heretofore regarded as more or less of trade secrets, but recently the Sawyer-Man Electric Company, in a pamphlet on the Sawyer-Man lamp, has given a brief account of the various steps in the making of its product. As the subject will, we believe, be one of interest to many of our readers, we present a condensation of that portion of the pamphlet treating of the details of a Sawyer-Man lamp. The accompanying illustrations will assist in following the description.

As a result of 20 years of careful investigating and experimenting, a filament is now being made which is so tough that it is not affected in any way by the rough usage to which it is subjected during the life of a lamp; so elastic that when forced out of its moulded curves it will spring instantly back like a steel wire, and so enduring that in the finished lamp it will glow with almost undiminished brilliancy for many hundred hours at a temperature of 1,500° to 1,600° C.

To form the filaments, a solution of cellulose is squirted through

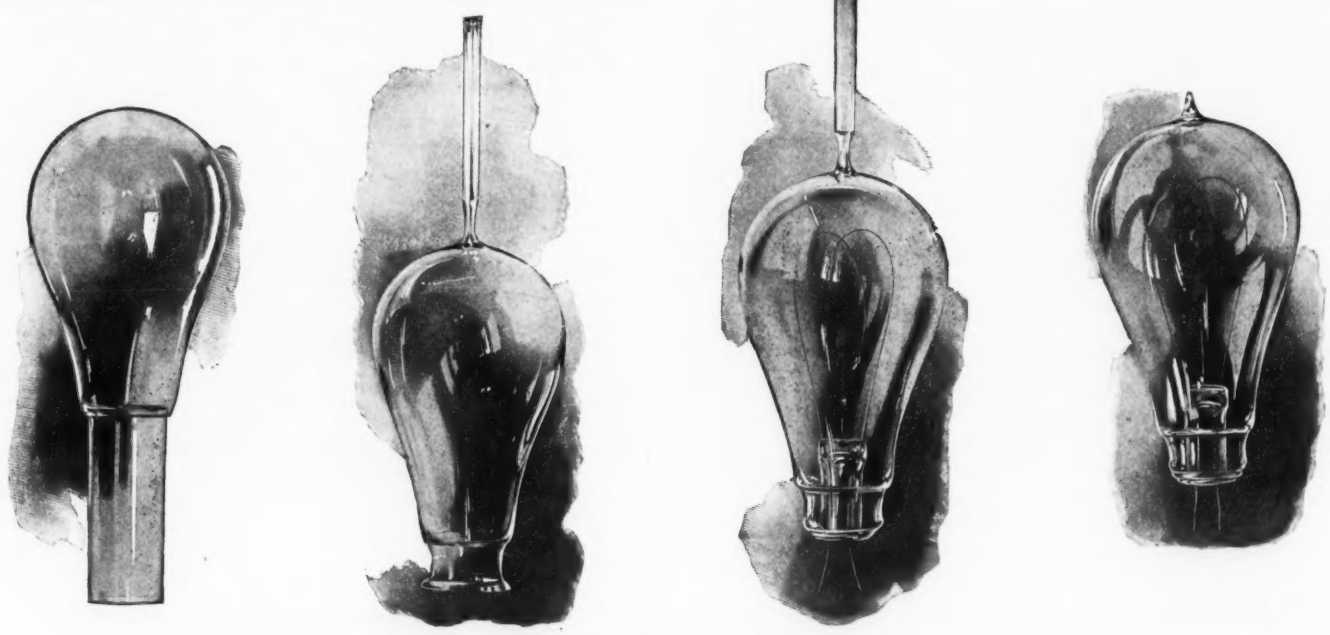
dies, emerging from the dies in the form of fine threads, which, when dried, are tough and flexible. After being formed into the shapes desired for use in the lamps, the threads of cellulose are packed in crucibles with carbon dust and subjected to intense heat for many hours, which completely chars the cellulose, and, so to speak, leaves only the carbon skeleton of each thread.

The next process is that of "treating," which consists in suspending the filament in an atmosphere of hydrocarbon vapor maintained at a pressure considerably below that of the atmosphere by means of an air pump. Through the filament is then passed for a few seconds,



FIGS. 1 TO 4.—THE FILAMENT AND ITS MOUNTINGS.

a current of electricity of sufficient strength to bring it to incandescence. At this very high temperature the hydrocarbon vapor is decomposed, carbon in a form resembling graphite being deposited on the filament. Before treating, all filaments vary more or less in diameter. At points of smaller diameter the resistance is greater and more heat is generated than at other parts of the filament. These points, being at a higher temperature, would disintegrate and break long before the rest of the carbon had served its useful life. During the process of treatment, however, these hotter portions



FIGS. 5 TO 8.—THE BULB IN ITS VARIOUS STAGES.

decompose the vapor more rapidly than the rest of the filament does, and so are built up by the deposited carbon. The result of this process, which requires only a few seconds, is that the thread now possesses a remarkably uniform structure.

It should be added that the high degree of skill now attained in the manufacture of filaments results in a product so uniform that the process of treatment for the defects just mentioned is no longer imperatively necessary. Nevertheless, it is still in use, since it produces an important change in the surface finish of the filament, which is a most vital matter. Before treatment the filament has a glossy, jet black surface; after treatment it has a metallic lustre, resembling polished steel. This metallic surface radiates heat less readily than the black surface, and, consequently, for a given expenditure of electric energy a larger amount of carbon can be kept hot. The increase in the mass of carbon thus made possible is an advantage in two ways; it enables the lamp maker to use a thicker, more substantial filament; and this filament, having a greater surface, need not be kept at quite so high a temperature to give equal light. Illustrative of the importance of this difference in temperature is the fact that a lamp burning at 1,550° C. will burn ten times as long as a lamp burning at 1,605° C.

Coming now to the terminals, the only satisfactory material is platinum, to which fused glass adheres very firmly, and which on cooling contracts at the same rate as the cooling glass. Any other metal would either cause the glass to crack or would separate by a minute distance from the glass. In either case it would leak into the interior of the lamp. Platinum is a very expensive metal, and it is desirable to use as little as posible, hence short pieces of platinum wire are fused to the ends of longer copper wires. Two of these platinum tips are then fused or sealed into the end of a bit of glass tubing having a flange spun on one end, from which the copper wires are left protruding. This combination is now called the mount or stem.

The next operation consists of fastening the filament to the mount. This is temporarily accomplished by means of a special composition which will stand a red heat and which will give off no gases when the lamp is burning. This latter point is important since such gases would impair the life of the lamp and cause rapid deterioration. Over this paste is deposited a layer of carbon very similar to the carbon deposited during the treatment of the filament, though in this case the filament is locally heated at the point of union

with the platinum in a bath of liquid hydrocarbon. This deposited carbon insures a joint that is both mechanically and electrically perfect. When the filament is to be anchored, which is done except in the case of lamps having short, stiff carbons requiring no support, this is accomplished by bending the end of a nickel anchor wire, fused in the mount, into a small hook and placing in this the loop of the filament, holding the latter in place by means of a drop of the composition already referred to. The mount is then placed in an oven to dry the paste thoroughly. The filament, next straightened by bending the platinum leading-in wire, is now ready to be sealed into the bulb.

Bulbs are blown in molds, a practice that insures exact uniformity in size and shape. As they come from the glass house they are perfectly smooth at the rounded end, and have a long neck, which is cut off with the aid of a glass worker's file. To the rounded end is fused a short length of glass tubing opening into the interior of the bulb. This is used subsequently to connect the lamp to the pump that exhausts the air.

Into the bulb thus prepared is forced the mounted carbon; the flange in the mount is brought even with the edge of the neck of the bulb, and the two are fused together. After being tested for leaks arising from imperfections in the glass work, and inspected for any defects in the bulb, mount or shape of the filament, the lamps are delivered to the exhausting department.

The exhaustion of air is accomplished by means of a highly perfected mechanical pump, constructed especially for this work. The last traces of air or gas are removed by chemical means. When the vacuum is sufficiently high, the tube through which the air has been exhausted is sealed off by means of a small hand torch, leaving the small rounded tip seen on the spherical end of a lamp bulb.

The lamps are further tested for vacuum by electrical means, which enable the operator to ascertain at a glance whether or not the lamp is defective in this respect. Also, to preclude the possibility of using any filaments which are "spotted"; that is, of which portions will burn more brightly than the rest, and which would prematurely break at these bright points; the lamps are repeatedly lighted and extinguished, being made to glow dimly at first, and eventually quite brightly. The practiced eye of the inspector detects the slightest imperfections, and he accordingly rejects lamps which a less skilled observer would pronounce perfect.

The filaments are now measured for candle-power. For this purpose each lamp is separately compared with a standard lamp mounted in a photometer. Here is determined the exact voltage at which each lamp will give its nominal candle-power, as well as the amount of current which it will consume in proper service. These measurements are made by skilful operators, the photometer equipment being supplemented by numerous devices which long experience has suggested as useful in obtaining the highest accuracy on the basis of a commercial operation. The illuminating power of a lamp is measured in a horizontal plane while the lamp is rotating about its own axis at 180 r. p. m. This rotation insures an exact determination of the average illumination of the lamp in all horizontal directions.

The bases now to be attached are secured to the lamp by means of a cement, which is applied at the points where the metal of the base touches the glass. This cement is superior, both in regard to durability and neatness, to the plaster-of-paris fastening which was formerly used, and is still used by some makers. After the lamps have been fixed in the bases, the leading-in wires are trimmed off and soldered to the bases, the lamps are lighted to detect either broken wires or short-circuits, and sent to the shipping department. They are here tested, cleaned, polished, labeled, wrapped in tissue paper and packed for shipment.

Automatic Car-Type Circuit-Breaker.

The protection of railway motor equipments by the use of a fuse has until recently been the standard practice. The results obtained usually have been satisfactory only to a limited degree, as the fuse frequently fails to blow at the proper time, or to give the equipment the best protection under all conditions of service. The necessity of carrying extra fuses, as well as the inconvenience of stopping the car to replace a blown-out fuse is held to be more or less of an objection to this method, and many of the largest street railway companies have replaced the fuse block with the automatic car circuit breaker. This practice, they consider, offers better protection to the equipment, as it reduces to a minimum the possibility of injury to the apparatus arising from the carelessness of the motorman in improperly cutting out resistance. The circuit breaker will open automatically when the current reaches the value for which it is set.

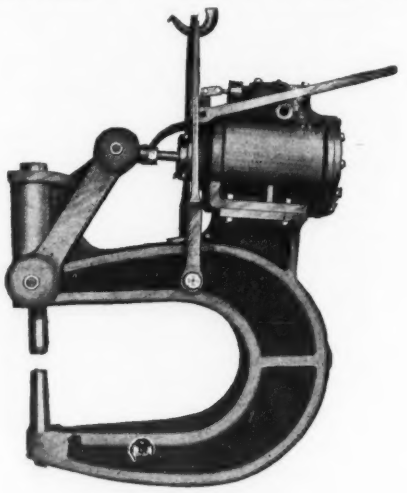
Aside from the protective feature of a circuit breaker, the convenience in resetting it is obviously of great value. The motorman in throwing the handle of the breaker after the occurrence of a heavy overload or short-circuit is not required to leave his position at the controller to put the car in service. In most cases it is not necessary to stop the car, as the breaker can be reset while drifting.

The automatic car circuit breaker manufactured by the Westinghouse Electric and Manufacturing Company performs the function of the fuse block by opening an overload or short-circuit; it also replaces the platform or canopy switch, in that it provides a hand opening for the circuit. In construction, the instrument is thoroughly fire-proof; of the best material and workmanship throughout, and all parts are interchangeable. Its design prevents any arcing at the current-carrying contacts, as the arc is broken on extra contacts especially provided for the purpose, and assisted by a powerful magnetic blow-out which will open the severest short-circuit without damage. The breaker is calibrated, and can be set to open at any current within the limit of its range. The automatic opening device insures absolute certainty in opening when the current reaches the predetermined value—a feature not found in any latch device, particularly if it is exposed to such weather conditions as are found in the vestibule of a street car.

AUTOMATIC CIRCUIT BREAKER.

Jaw Riveter.

The accompanying illustration gives a view of one of the several styles of pneumatic riveters made by John F. Allen, 370 Gerard Avenue, New York. The jaws of this machine measure 25 inches, and will straddle the edge of girders and beams having 6-inch angle irons on each side. The riveter is operated by a 10-inch cylinder and is powerfully constructed. It is made in 16 different sizes, varying in reach from 6 to 66 inches, and may be operated by steam as well as by compressed air. The British Westinghouse Electric and Manufacturing Company, Manchester, England, has four of these riveters in use, and the Canadian General Electric Company has one at its Toronto shops. Several other large concerns are using these riveters in their daily work.



JAW RIVETER.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money closed at 4½ to 5 per cent. for 30 to 90 days, and 4¾ to 5 per cent. for four to six months. In the stock market there was some irregularity, although there was a strong tone. Favorable crop prospects kept up the bullish tone in connection with the granger stocks, and soft coal shares advanced materially. Manhattan was weak on reports of a possible strike of its engineers, and industrials were neglected. Brooklyn Rapid Transit was weak under poor July earnings statement and talk of the possible resignation of its president. The United States Steel stock were dull. In Boston, General Electric closed with a net loss of 10 points ,and American Telephone and Telegraph ⅝ of a point, the market being quiet. Tractions closed weak at New York, Met. St. Ry. at 148¾, a net loss of 1 point, and Brooklyn Rapid Transit at 68¾, a net loss of ½ point. General Electric made a net gain of ¼ point on sales of 1900 shares, the closing figure being 185½, which was only ½ point below the highest figure of the week. Am. Tel. & Tel. kept unchanged at 164, this quotation representing a net loss of 1 point. Western Union closed at 88¾, being a net gain of 1¼ point. Following are the closing quotations of August 12:

NEW YORK.

	Aug. 5.	Aug. 12.		Aug. 5.	Aug. 12.
American Tel. & Cable.	93⅞	87	Hudson River Tel.....	—	—
American Tel. & Tel..	164	163½	Metropolitan St. Ry...	149	148½
American Dist. Tel....	—	—	N. E. Elec. Veh. Trns.	10½	—
Brooklyn Rapid Transit.	69¼	67⅝	N. Y. & N. J. Tel....	—	—
Commercial Cable	—	155	N. Y. E. V. T. Co....	—	11⅝
Electric Boat	25	23	Tel. & Tel. Co. Am....	—	—
Electric Boat pfd.....	50*	40	Western Union Tel....	89	91¾
Electric Lead Reduc'n..	2½	2¼	West. E. & M. Co.....	—	215
Electric Vehicle	7⅛	6½	West. E. M. Co. pfd..	—	—
Electric Vehicle pfd....	14½	14			
General Electric 185¼		185			

BOSTON.

	Aug. 5.	Aug. 12.		Aug. 5.	Aug. 12.
American Tel. & Tel..	163¾	162½	Western Tel. & Tel. pfd.	—	—
Cumberland Telephone.	—	—	Mexican Telephone	2¼	2¼
Edison Elec. Illum....	280	—	New Eng. Telephone...	142	142¾
Erie Telephone	—	—	Westinghouse Elec.	—	106½
Western Tel. & Tel....	—	—	Westinghouse Elec. pfd.	—	106½

PHILADELPHIA.

	Aug. 5.	Aug. 12.		Aug. 5.	Aug. 12.
American Railways	47¾	50	Phila. Traction	99¾	99½
Elec. Storage Battery..	—	88½*	Phila. Electric	5⅝	5⅝
Elec. Storage Bat'y pfd.	—	87	Pa. Elec. Vehicle.....	—	—
Elec. Co. of America..	8⅞	8⅝	Pa. Elec. Vehicle pfd..	—	—

CHICAGO.

	Aug. 5.	Aug. 12.		Aug. 5.	Aug. 12.
Central Union Tel.....	—	—	National Carbon pfd....102½		100
Chicago Edison	—	—	Northwest Elev. com...	—	36½
Chicago City Ry.....210		220	Union Traction	—	15
Chicago Tel. Co.....	—	—	Union Traction pfd....	47	—
National Carbon	30	31			

* Asked.

JERSEY TROLLEYS.—It is reported that the merger of the North Jersey Street Railway Company, of Jersey City and Newark; the Jersey City, Hoboken and Paterson Railway Company, and other trolley lines in Northern New Jersey had been effected, and that formal announcement of the consolidation will be made this week. It is said that Prudential Life Insurance Company interests are represented in the new combination, and that they sanctioned an offer of 38 for North Jersey Company stock, and 28 for the stock of the Jersey City, Hoboken and Paterson Company. North Jersey stock was quoted at 34⅞, and Jersey City, Hoboken and Paterson at 24⅝ last week. It is also said that the consolidation agreement has been signed by leading officials of the companies affected. Chandler Riker, of Newark, is the promoter of the new combination, which, it is said, includes all the street railway systems of Hudson, Essex, Union and Passaic counties and other portions of the State, the middle system, including Middlesex and Monmouth, and the seacoast system, all the principal lines in South Jersey and the lines in Staten Island. It is said to be the intention of the syndicate to make many changes and improvements, and to extend lines and construct a tunnel under the Kill von Kull from New Jersey to Staten Island. One of the advantages in merging the roads will be economy in maintenance and operation.

OTIS ELEVATOR.—A special meeting of the stockholders of the Otis Elevator Company has been called for Sept. 8, to take action on the question of the proposed amendment of the certificate of incorporation by the increase of the authorized capital stock of the company in the sum of $2,000,000, such increase to be preferred stock, to have the same privileges as the present preferred stock. This action is deemed necessary in view of the continuing increase and expansion of the company's business. Of the proposed increase, $1,000,000 will be offered to the stockholders, so that each stockholder, both common and preferred, will have the right to purchase at par such preferred stock to the amount of 10 per cent. of his holdings. The balance of the authorized preferred stock will remain in the treasury, to be issued only as the necessities of the company may require.

STATEN ISLAND PROPERTIES.—The properties of the Staten Island Electric Railroad Company and the New York and Staten Island Electric Company were sold by auction last week. The property of the company was bought in for $250,000 and that of the New York and Staten Island Company for $10,000. The purchaser in both cases was William L. Bull, chairman of the Reorganization Committee formed to control both properties. The two properties have been in the hands of Receiver John Greenough since March 1. According to the plan of the committee the two companies are to be incorporated on Sept. 1 as the Richmond Light and Railroad Company. The property of the New Jersey and Staten Island Ferry Company, which is connected with the other companies, was to have been sold also, but it was withdrawn.

INTERBOROUGH RAPID TRANSIT.—A special meeting of the stockholders of the Interborough Rapid Transit Company, of New York City, has been called for August 26, to consider an increase in the capital stock of the company from $25,000,000 to $35,000,000. The reason for the proposed increase is that the additional capital is required to meet the cost of the Brooklyn extension of the rapid transit subway. It is estimated that the extension will cost about $10,000,000, while the bid of the company was for $3,000,000. The call for the special meeting is signed by August Belmont, president, and Frederick Evans, secretary. The increase of capital will be effected by the issue of 100,000 new shares of the par value of $100 each.

INDEPENDENT TELEPHONE DEAL.—A dispatch from Richmond, Va., of August 11, says: The absorption of the Winchester Telephone Company by the United Telephone and Telegraph Company, of Philadelphia, was officially announced to-day. The new company controls 30,000 telephones, and will acquire 30,000 more. It is its intention to enter New York. The officers of the new company are: President, R. T. Barton, of Winchester; vice-president, W. D. Bernard, of Philadelphia; treasurer, S. R. Caldwell, of Philadelphia; local manager, S. L. Hoover; general manager, W. J. Latta, Philadelphia; Directors, T. J. O'Neill, Hanover; C. M. Clement, Sunbury, and S. H. Hansbrough and W. H. Baker, Winchester.

BOSTON ELEVATED STOCK.—The Railroad Commission held a hearing upon the petition of the Boston Elevated to issue $5,000,000 of new stock. Counsel Snow appeared for the company. He presented a table showing that the Elevated Company has expended $3,754,023 above the amounts estimated by the Railroad Commissioners as necessary to build the road when the $10,000,000 stock was authorized. The elevated people stated to the Railroad Commissioners that a price of $125 for the new stock would be satisfactory to them, and they did not think it should be above this figure, as the earnings of the road would not be increased through any of the money obtained by the new issue.

BOSTON EDISON.—The Boston Edison Company is gradually selling the several parcels of land secured through the purchase of the Boston Electric Light Company. The company's adjourned special meeting, to take final action upon new stock issue, will be held August 20. The gas commissioners recently authorized the company to issue 16,500 new shares at $200 a share, increasing the company's capital 20 per cent. It is understood that the stockholders will be asked, August 20, to vote an increase in the capital of but 10 per cent., the remainder of the authorized issue probably to issue next year. The earnings of the company are large and progressive.

SALE OF BELL STOCK.—At Boston last week R. L. Day & Co. sold at auction 881 shares of stock of the American Telephone and Telegraph Company, by order of the directors. After spirited bidding, the stock was sold as follows: 826 shares to Curtis & Sanger, at 163⅝; 50 to R. L. Day & Co., at 163¾; 5 to R. L. Day & Co., at 164. The larger lot will doubtless be split up for investors.

CAR LIGHTING DEAL OFF.—Dispatches from Albany, N. Y., state that negotiations for the consolidation of the Consolidated Car Heating Company, of that city, with the Safety Car Heating and Lighting Company, of New York, and the Gold Car Heating Company, of New York, have been entirely suspended.

DIVIDENDS.—The directors of the Kings County Electric Light and Power Company have declared the regular quarterly dividend of 1¼ per cent., payable Sept. 2. The directors of the Niles-Bement-Pond Company have declared a semi-annual dividend of 4 per cent. on the common stock, one-half payable Sept. 15 and one-half payable Dec. 15. The directors of Pratt & Whitney Company have declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable August 15. Metropolitan Elevated directors, of Chicago, have declared a semi-annual preferred dividend of 1½ per cent., payable August 30.

ST. LOUIS UNION BONDS.—The Union Electric Light and Power Company, of St. Louis, is to issue $10,000,000 five per cent. gold bonds.

Commercial Intelligence.

THE WEEK IN TRADE.—The midsummer quiet in distributive trade has disappeared, and, stimulated by brilliant crop prospects and good prices for farm products, Fall business has begun to expand, says *Bradstreet's*. Buyers are arriving in large numbers at all markets. The manufacturing industry continues well employed, and failures are few and liabilities small. July railway earnings returns so far reported show 7 per cent. gain over last year. The car famine trouble is a subject of complaint, and this promises to extend to other lines. The weight of imported iron is present on the domestic sentiment, though no perceptible effect is yet seen on prices for pig iron, which is still in active request for next year's delivery. Steel rails, bolts, bars and sheets are active at the West, but the edge of the demand for plates and sheets appears to have been taken off at Pittsburg. Structural material is active at Chicago and at Pittsburg, where sales have been very large. Shipbuilding interests have taken 40,000 tons of plates at Pittsburg. Western machinery manufacturers are crowded with orders. The copper market is very dull, and little metal has been offered for sale, changing hands at slightly lower prices. Following are the last quotations: Lake, 11¾ @ 11⅞c., electrolytic in cakes, wire bars and ingots, 11½ @ 11⅝c; cathodes, 11¼ @ 11⅜c., and casting stock, 11½c. The business failures for the week ending August 7, as reported by *Bradstreet's*, numbered 169, as against 168 the week previous and 185 the same week last year.

WESTINGHOUSE, CHURCH, KERR & CO. have under fulfilment a number of important contracts for railway, lighting and power properties. Metropolitan Street Railway—Third Avenue division: The designing of the entire Kingsbridge station and the installation of boiler, engine, condenser and generator equipments. This station contains one of the largest aggregations of power generating machinery in the country. Meriden Electric Light Company, Meriden, Conn.: The entire remodeling of the present lighting plant, rebuilding and extension of boiler and engine room, and the installation of an entire equipment of new machinery. Lackawanna & Wyoming Valley Railroad: The designing and construction of one of the most important high-speed interurban roads in the country. American Car and Foundry Company, Berwick, Pa.: The erection of an entire car manufacturing establishment, similar to that just completed for the same concern at Detroit, Mich. Rochester, Auburn & Syracuse Railway: Design and construction. This road is also an important interurban road, representing the most advanced engineering practice. Pittsburg & Lake Erie Railway: McKees Rocks, Pa.: Complete mechanical equipment for large railroad shops and terminal station now building at this point. Champion Coated Paper Company, Hamilton, Ohio, and American Smelting and Refining Company: Extensive high-pressure steam piping outfits. Nikola Tesla, Wardencliffe, L. I.; Electrical equipment, steam engines, auxiliary apparatus, steam piping, etc. Walter W. Law, Briarcliffe Manor, New York: Electrical heating and refrigerating outfits for suburban isolated plant and villa. The Phipps residence, New York: Complete mechanical, electrical, heating and refrigerating outfits for isolated plant.

FORT WAYNE ELECTRIC GATHERING.—During the week beginning July 28th, the district managers and agents of the Fort Wayne Electric Works held a convention at the home office, which was very interesting because of its business features and the social enjoyment of the occasion. Representatives from all the large cities in which the company has sales offices were present. Mr. F. S. Hunting, general sales manager, made the evenings of the week especially interesting in a social way by a trolley and theatre party to Robinson Park, and the week was fittingly ended by a banquet tendered by the Fort Wayne Electric Works to the district managers and sales agents at the Wayne Club. There were present Lieut.-Governor Gilbert, H. C. Paul, president of the Fort Wayne Electric Works; Hon. R. S. Taylor, and several local directors. Judge Taylor gave a very interesting early history of the business and the early struggles of the founders of the Fort Wayne Electric Works, and related how he and R. T. McDonald, when working together to gather evidence to defend an infringement suit brought against the infant concern for manufacturing an arc lamp, "discovered Mr. J. J. Wood." The representatives present were: J. Allan Smith, Boston, Mass.; E. B. Goldsberry and C. A. Woolsey, Philadelphia, Pa.; A. E. Dresser, Syracuse, N. Y.; J. E. Hall, Pittsburg, Pa.; T. J. Ryan, Cincinnati, Ohio; T. W. Dixon, St. Louis, Mo.; A. H. Savage, St. Paul, Minn.; W. S. Goll, W. C. Knight, Frank McMaster, Chicago, Ill.; A. L. Searles, Grand Rapids, Mich.; J. C. Lott, New York, N. Y.; T. L. Sturgeon and Fred L. Reynolds, of the home office.

THE A. G. SCHOONMAKER COMPANY, of 126 Liberty Street, New York City, reports a very satisfactory state of trade. This Company is the representative of the Eager Electric Company, of Watertown, N. Y., builders of direct-current apparatus. Among the recent installations of the Eager apparatus may be mentioned: J. H. Lebkuecher, Newark, N. J., six 150-kw direct-connected generators; The Analomink Paper Company, Water Gap, Pa., one 30-kw direct-connected generator; The Black River Traction Company, Watertown, N. Y., two 200-hp engine-type, direct-connected, street-railway generators; one 50-kw booster set. The Schoonmaker Company carries in stock a full line of Ward Leonard starting boxes, in all sizes, and a full line of smaller new motors, at 220 and 500 volts. The shipment of rebuilt cars and motors is conducted from shops in Brooklyn. Among recent work may be mentioned: A large vestibuled motor car for the Moline, East Moline & Watertown Railway Company, Moline, Ill.; several open cars for the East Bangor, Portland & Delaware River Street Railway Company, Bangor, Pa. Several 150-ton hydraulic wheel presses have been shipped during the past month.

BELL TELEPHONE INSTRUMENTS.—The instrument statement of American Telephone and Telegraph for the month ended July 20, 1902, and the seven months since Dec. 20, 1901, follows. Month ended July 20:

	1902.	1901.	1900.
Gross output.....	59,935	56,526	65,463
Returned	34,054	30,241	30,093
Net output.....	25,881	26,285	35,370
Seven months from Dec. 20:			
Gross output.....	649,044	526,449	411,609
Returned	260,321	224,810	162,753
Net output	388,723	301,639	248,856
Total outstanding.	2,914,735	2,254,455	1,839,361

THE KENTUCKY ELECTRICAL COMPANY, Owensboro, Ky., are moving into their new factory, a two-story brick building, their business having increased so rapidly in the past year that they have been compelled to increase their capacity. In their new quarters, the lamp department will be equipped with modern appliances and have an immediate daily capacity of 3,500 incandescent lamps, with ample room to increase this output to 5,000 per day. In the dynamo and motor department, all machine tools will be electrically driven and with facilities for building up to 50-kw. Their present line will be increased immediately to 30 kw. Their dynamos and motors have given excellent satisfaction, their present facilities having been taxed to their utmost for many months to supply the demand. Mr. A. W. Stuntz is secretary and electrical engineer.

THE NERNST LAMP COMPANY, of Pittsburg, Pa., reports having closed a contract with the Lunkenheimer Company, of Cincinnati, Ohio, for 238 lamps, and has just completed the installation of a large number of lamps in Messrs. Atha & Atha's store, Pittsburg. It has another large contract with the Commercial Electrical Company, of St. Louis, and contracts with various other concerns for 165 of its six-glower lamps, 250 three-glower, 115 two-glower and 871 one-glower. All of the above contracts were for lamps to be operated on alternating-current circuits.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY reports the sales of Westinghouse integrating wattmeters for the month of June to have been the largest in the history of the company. The sales of Westinghouse transformers have more than doubled in the past six months, and the transformer building capacity of the Westinghouse Company has been largely increased to meet the demand.

BALL ENGINE ORDERS.—The National Biscuit Company, of Baltimore, is installing an electric plant, consisting of two 300-hp cross-compound engines, direct connected to General Electric generators. A new addition to the power plant of the Lewis Institute, Chicago, will consist of a 150-hp engine, built by the Ball Company, direct connected to a 75-kw generator.

AMERICAN UNION ELECTRIC COMPANY.—With regard to our previous data on this new concern, Mr. S. Marsh Young, of the company, states that in addition to its purchase of the Union Railway Power and Electric Company, Morris Electric Company, The Falcon Electric Manufacturing Company, Electric Motor Specialty Company, Fountain Manufacturing Company, The Federal Manufacturing and Specialty Company, and Refrigerator Machine Company, it has added the Metropolitan Switchboard Company from Messrs. Chas. L. Eidlitz, T. J. Murphy and G. A. Annable. The American Union Electric Company intends to continue to operate the factory of the Metropolitan Switchboard Company at West Twenty-ninth Street, New York, as an auxiliary to its plant at Ampere, N. J., and in the Twenty-ninth Street factory will handle all switchboard and special panel-board work under the supervision of Mr. T. J. Murphy, former president of the Metropolitan Switchboard Company. The purchase of the Metropolitan Switchboard Company carries with it the ownership of the "Murphy" patents, which cover forms of installation of panel boards, as well as built-up panel board boxes and the divisible panel board. The American Union Company announces that it will probably turn in these patents to the general benefit of the panel board business, and will issue licenses to panel board manufacturers, its object being to strengthen the general situation and to enable the legitimate panel board manufacturers to receive a fair return on their investment. The new additions to the factory of the American Union Electric Company, at Ampere, N. J., covering about 23,000 square feet of floor space, are about completed, although plans are being prepared for the still further addition of a new brick building 300 x 50 feet for a general machine shop, as well as office building and warehouse.

EXPORTS OF ELECTRICAL MATERIALS.—The following are the exports of electrical materials and machinery from the port of New York for the week ended August 9: Argentine Republic—306 pkgs. material, $5,537. Almeria—1 pkg. material, $165. Antwerp—19 pkgs. material, $1,553; 7 pkgs. machinery, $1,120. Brazil—80 pkgs. material, $3,312; 7 pkgs. machinery, $224. Brussels—3 pkgs. material, $171. British West Indies—13 pkgs. material, $260. Berlin—1 pkg. machinery, $116. Barcelona—14 pkgs. material, $178. British East Indies—12 pkgs. material, $725. British Australia—72 pkgs. machinery, $3,379; 65 pkgs. material, $1,051. Cuba—28 pkgs. material, $794. Copenhagen—2 pkgs. material, $705. Chili—72 pkgs. material, $3,584. Central America—17 pkgs. material, 297. Dutch West Indies—2 pkgs. material, $18. Egypt—9 pkgs. material, $434. Glasgow—16 pkgs. machinery, $1,175; 4 pkgs. material, $165. Havre—9 pkgs. machinery, $587; 11 pkgs. material, $305. Hamburg—37 pkgs. material, $2,540. London—108 pkgs. machinery, $1,570; 157 pkgs. material, $7,642. Liverpool—207 pkgs. machinery, $12,220; 35 pkgs. material, $1,962. Mexico—93 pkgs. material, $3,318. Manchester—227 pkgs. machinery, $25,599; 1 pkg. material, $21. Nova Scotia—29 pkgs. material, $205. New Zealand—1 pkg. machinery, $58. Newfoundland—2 pkgs. machinery, $90. Odessa—8 pkgs. machinery, $315. Peru—10 pkgs. machinery, $116. Rotterdam—2 pkgs. machinery, $80. Southampton—83 pkgs. material, $1,026. Stockholm—5 pkgs. material, $130; 2 pkgs. machinery, $1,000. Strasburg—1 pkg. machinery, $120. Uruaguay—1 pkg. material, $40. U. S. Colombia—3 pkgs. machinery, $159. Venezuela—52 pkgs. material, $737.

STREET SIGN LIGHTING.—President Cantor, of New York, has awarded the contract for the placing of 6,000 dark-blue enameled street signs and 2,000 street sign boxes with reflectors, deflectors and radiators, to be attached to existing poles. When the bids were opened it was found that there were no bidders for the 1,200 street sign boxes of two different patterns, one for electric light and the other for gas light, to be erected on existing lamp-posts, fire-alarm and electric-light poles. President Cantor was surprised because no bid was received for this work. Two bids were received for the dark-blue enameled street signs. The first was that of Wilfred Buckley for the signs at 90 cents, and the other was from the Imperial Enamel Company at 98 cents. President Cantor referred the Buckley bid to Corporation Counsel Rives, as he claimed that it was informal, and later he awarded the contract to the Imperial Enamel Company at 98 cents. The bidder for Contract No. 3 was the Electric Reflector Company, which bid as follows: Common rectangular signs, $20 each; triangular signs, $18 each; rectangular signs with four-lettered signs, $12.50 each; rectangular signs lighted by Welsbach lights, $17.50. As this bid was the only one, the contract will have to be awarded to this firm. President Cantor ordered that Contract No. 2 be readvertised both with and without the maintenance clause, and with and without the lighting clause.

SOME GOUDEY-McLEAN EXPORT ORDERS.—The Goudey-McLean Company, of 88 Maiden Lane, New York, export sales managers for a number of American manufacturers of electrical machinery, etc., have just secured several fair-sized orders for motors, etc., to be shipped to the European markets. The Scottish Goudey-McLean Company, which was recently organized to look after interests in Scotland, has sent in orders within the last week or two for a number of motors, varying from 15-hp to 3½-hp. These motors are to be supplied by the Milwaukee Electric Company and the Browning Manufacturing Company, of Milwaukee, Wis. The American Electric Syndicate, of Vienna, which attends to the Goudey-McLean interests in Austria, has also requisitioned for several small motors of Browning build. Edge & Edge, of Sydney, New South Wales, have sent in a substantial order for lightning arresters, to be furnished by the Garton-Daniels Company, of Keokuk, Ia.

ROTARY TRANSFORMERS FOR SAN FRANCISCO.—The United Railroads of San Francisco has closed a contract with the General Electric Company for two 500-kw rotary transformers, which will be installed at the new San Bruno sub-station. They will be served from the three-phase plant which is being constructed by the company in the northern part of the city, and will be in operation next October. The rotaries will supply direct current at 600 volts, to operate electric cars between San Mateo and San Francisco. The electric power plant will have a capacity of 16,000 hp, and half of this capacity will be installed at once.

HYDRAULIC BIDS.—The Cloverdale Electric Light and Power Company is about to receive bids for its hydraulic work. A. E. Sharboro, of San Francisco, has been granted a right of way through condemnation proceedings for a pipe line and flume over the lands of the W. P. Ink estate. The plant will be located on Sulphur Creek, and electric lights will be supplied in Cloverdale and at Asti, where the winery of the Italian-Swiss colony is located. The transmission line will be extended to other points. The Engineering Offices, San Francisco, have charge of the work on this water power electric system.

ELECTRIC ELEVATORS.—The first Manhattan elevated station to have electric elevators will be the new one at West One Hundred and Tenth Street. The Otis Elevator Company have received an order from the Manhattan Railway Company for heavy electric passenger elevators to be installed in the new station, each to have a maximum lifting capacity of 3,300 pounds and a speed of 300 feet per minute. The travel of each car will be 60 feet. One week's orders showed 51 electric elevators and 15 hydraulic—possibly a good illustration of the trend of things.

NEW INSULATOR FACTORY.—Several independent telephone people contemplate the erection of a large glass factory at Toledo, Ohio, where will be manufactured glass insulators for telephone lines. The men interested are : E. L. Barber and James Brailey, of the Home Telephone Company; C. H. Roser, of Lima, Ohio; C. K. Duffy, of Lynn, Mass.; W. W. Townsend, of Chicago; Walter F. Ritchie, of Lima; James Brailey, Jr., of the Home Telephone Company; John A. Conway, of Detroit; C. N. Haskell, of Ottawa, Ohio.

ENGINES FOR COSTA RICA.—The United Fruit Company, of Boston, at 24 State Street, New York, has placed a contract through the American Supply and Construction Company, 120 Liberty Street, for three 150-hp belted engines, to be built by the Harrisburg Foundry and Machine Works. The engines will be utilized for operating an electric light and power plant on the Fruit Company's banana plantations in Costa Rica, Central America.

LIGHTING PLANT FOR JAPAN.—The Kyoto Electric Light Company's plant, Kyoto, Japan, is to be equipped with a 500-hp cross-compound condensing engine, to be built by the Buckeye Engine Company, of Salem, Ohio, for direct connection to a 350-kw generator of General Electric manufacture. The order was placed through the American engineering and contracting firm of Bagnall & Hilles, of Yokohama.

JAMES J. MURRAY & CO., of Philadelphia, Pa., whose plant was struck by lightning on July 25, report that it was but slightly damaged. They made temporary arrangements to fill all orders for their electric and other glassware, as their two furnaces were uninjured, and they were able to resume operations in full by August 1.

CAR FENDERS FOR SOUTH AFRICA.—The Consolidated Car Fender Company, of Providence, R. I., has secured a contract from the British electrical engineering and contracting firm of Macartney, McElroy & Company, 26 Cortlandt Street, for 60 equipments for the Durban, South Africa, electric traction system.

WIRELESS TELEGRAPH CONTRACTS.—The De Forest Wireless Telegraph Company has been informed by Col. H. H. C. Dunwoody, of the Signal Corps, Department of the East, United States Army, that its bid for the installation of wireless stations connecting Fort Wadsworth and Fort Hancock has been accepted.

NEW YORK CITY PLANT.—An ordinance has been approved by Mayor Low to provide $200,000 corporate stock for the construction and installation of a new heating and lighting plant in the American Museum of Natural History, near Central Park, New York.

MATERIAL FOR JAPAN.—General Electric Company has, it is said, chartered a steamer, which has been loaded at New York with a cargo of electrical appliances and machinery for Japan, to fill large contracts there.

General News.

THE TELEPHONE.

PHOENIX, ARIZ.—By the extension of the Sunset Telephone Company's Castle Creek line, Phoenix and Wickenburg, Ariz., are now connected.

PHOENIX, ARIZ.—The Lawson Telephone Company has been incorporated at Phoenix with a capital of $100,000, by J. Atkins, A. F. Lawson and W. A. Crawford, of Buffalo, N. Y.

AUGUSTA, GA.—The street committee has recommended the adoption of an ordinance, giving both the existing telephone companies the right to place their wires underground and not increase the cost of telephones.

NEX PERCE, IDA.—The Nez Perce Co-operative Telephone Company, recently organized, has now 50 subscribers and 45 miles of wire in operation. It will extend its lines to Lewiston and other points.

GILLESPIE, ILL.—The Gillespie Telephone Company, Gillespie, capital $5,000, has been incorporated by Jonah C. Steere, J. M. Rodiner and Henry R. Williams.

CHESTER, ILL.—The Gordon Telephone Company has received its cable to be placed under the river from Chester to Clearyville, and as soon as the cable is laid the line will be extended to Perryville, St. Mary's and other towns in Missouri.

CHICAGO, ILL.—The Chicago Telephone Company's business for July showed an increase of 1,000 instruments installed, but this is said to be 33 per cent. less than the average monthly increase this year. Officials of the company attributed the falling off to bad weather, which prevented outside work very materially.

GREENVILLE, ILL.—The Kinloch Telephone Company has announced the completion of its toll lines to this city, and that work of construction is being pushed steadily toward Terre Haute, Ind. The new telephone toll line follows the right of way of the St. Louis, Troy and Eastern railway to Troy, Ill., and there the country roads are followed in an easterly direction. New stations have been opened at Highland, Pierron, St. Jacob, Shiloh and Greenville, and others will be opened in a short time. The construction gang has progressed to Vandalia, and many towns along the line will be connected up this summer.

SOUTH BEND, IND.—The Mishawaka City council has granted a franchise to the South Bend Telephone Company.

BRIDGETON, IND.—The Bridgeton, Mansfield and Diamond Co-operative Telephone Company, capital stock $1,000, has been organized.

NEW CASTLE, IND.—The Mount Summit Rural Telephone Company has been incorporated, with a capital of $10,000, by R. R. Leath, F. Shiveley, P. Jeffries and others.

SPICELAND, IND.—The Spiceland Co-operative Telephone Company has been incorporated. Capital stock, $10,000. H. W. Jones, Sesson Hudson, J. A. Spencer, J. T. Unthank and Nathan Foster are the directors.

CHRISMAN, IND.—The Portage Home Telephone Company of Chrisman has been incorporated. Capital stock, $10,000. Directors: H. D. Schofield, Claus Brink, E. G. Miller, W. A. Briggs, F. A. Malmstone, C. E. Fifield, J. H. Lenburg, H. G. Rollins and James Lenburg.

PEKIN, IND.—The Indiana Telephone Company has been incorporated for the purpose of constructing an exchange here and a telephone system throughout Washington, Clark and Scott Counties. The capital stock is $15,600. The directors are C. L. and J. T. Graves and D. W. Bowman.

STOCKWELL, IND.—The People's Co-operative Telephone, of this place, has incorporated with a capital stock of $6,000. The company will erect an exchange here and operate a system in Tippecanoe and adjoining counties. W. O. Land, M. C. Cann, J. W. Skinner and E. N. Stout are directors.

HENRYVILLE, IND.—The Overland Telephone Company has been incorporated to construct and operate telephone lines in Clark County. Capital stock, $1,000. An exchange will be erected in this place and service first given to the citizens here and to Borden, a village a few miles distant. Directors: Ernest Schleicher, D. M. Gray, P. S. Spurgeon, W. H. Dietrich, John Coats and D. W. Martin.

KIRON, IA.—The Kiron Telephone Company has been organized here. Ed. Ekman is president; E. R. Wood, vice-president; P. G. Lundell, secretary. Capital, $8,000.

DES MOINES, IA.—West Morgan Telephone Company of Franklin County, capital, $5,000, has been incorporated. H. S. Mendell, C. H. Larson and Thomas Durrant, directors.

HUMBOLDT, IA.—The Northern Telephone Company of Fonda is to build a new line out of Fort Dodge, running north to Humboldt, thence to Gilmore City, Pocahontas and Storm Lake.

WELLSBURG, IA.—The farmers between Wellsburg and Cleves have organized to erect and put in operation a telephone line. D. De Neui is president; Joe De Neui, Sr., treasurer, and Dr. Heddens, secretary.

DES MOINES, IA.—The Mingo Farmers' Mutual Telephone Company, of Mingo, has been incorporated; capital, $5,000; M. F. Berkley, president; W. W. Goodrich, secretary; Cyrus Eatwell, vice-president; H. K. Poorbaugh, treasurer.

SIOUX CITY, IA.—The Illinois Central Railroad will, about October, connect Sioux City with its Chicago offices by long-distance telephone. The 514-mile wire from Sioux City to Chicago will cost the railroad about $45,000, and the entire telephone system about $150,000.

OBERLIN, KAN.—Kansas & Colorado Telephone Company, Oberlin has been incorporated; capital, $10,000.

LOUISVILLE, KY.—The Western Kentucky and Galloway County telephone system has been sold to the Cumberland Telephone and Telegraph Company.

LEXINGTON, KY.—The directors of the Fayette Telephone Company have transferred the franchise of the company in Bourbon County to the Bourbon Home Telephone Company, which will build an exchange.

HOPKINSVILLE, KY.—J. E. Mott, of Huntington, Ind., has purchased for $3 the telephone franchise ordered sold some time ago by the city. The Cumberland Company claims to have a priority of franchise and refused to bid.

ADRIAN, MICH.—The Gilliland Telephone & Supply Company has been incorporated, with a capital of $10,000.

WESTON, MICH.—Plans are under way for the construction of an independent telephone system in and around Weston.

PARK RAPIDS, MINN.—The Citizens' Telephone Company of Park Rapids has incorporated with $10,000 capital. L. H. Rice, L. W. Bills, T. C. Myers, F. C. Rice and P. D. Winship are the directors.

HANNIBAL, MO.—The Missouri and Kansas Telephone Company is making extensive improvements on the local exchange. Nine thousand feet of new cable, recently purchased, will be placed in position.

VANDALIA, MO.—The Lacrosse Lumber Company, of Louisiana, Mo., has bought the Vandalia telephone system, paying $3,000. It will be made a part of the Buffum system, which extends all over this part of the State.

SKIDMORE, MO.—The Nodaway Valley Telephone Company, of this city, has been incorporated with a capital stock of $3,000, all paid. The incorporators are: Benjamin Bassett, W. B. Ward, G. W. Stricker, W. M. Howden, W. W. Grigsby, C. W. Brown and others.

SPRINGFIELD, MO.—The Home Telephone Company of Springfield has been organized with a capital stock of $100,000. The incorporators are: H. B. McDaniel, B. W. Redfearn, C. O. Trask, F. C. Curren, A. J. Eisenmayer and W. D. Tatlow, of this city, and J. B. Wear, of Detroit, Mich.

ST. LOUIS, MO.—Mr. W. E. Goldsborough, Chief of the Department of Electrical Exhibits of the World's Fair, reports that during his visit to Chicago a strong sentiment was developed among the independent telephone manufacturing companies of that city in favor of making elaborate exhibits in the Electricity Building.

ST. LOUIS, MO.—Without waiting for the completion of one branch exchange, the building for which is now being rapidly erected, the Bell Telephone Company has found it necessary to build another branch to take care of the increasing business in St. Louis. The latest addition to the exchange system will be erected at No. 324 North Beaumont Avenue, near Locust Street. It will be three stories high and will cost about $40,000.

COZAD, NEB.—The Cozad Mutual Telephone Company has been incorporated, with a capital stock of $2,000.

BANCROFT, NEB.—Articles of incorporation of the Bancroft Independent Telephone Company have been filed. The incorporators are: W. H. Watson, E. T. Rice, W. F. Sinclair and E. H. Morgan. The authorized capital stock is $15,000.

ALAMO GORDO, NEW MEX.—The Alamo Telephone Company, with a capital stock of $5,000 and with principal offices at this place, has been incorporated by O. L. Pearson, J. D. Bennett, J. R. Gilbert, A. J. Buck, Alfred Hunter and H. W. Schofield, who will also constitute the first board of directors.

DEPEW, N. Y.—A franchise has been granted to the Haines Telephone Company to operate in this village.

DUNDEE, N. Y.—The Crosby and Barrington Telephone Company has been organized; capital, $5,000; directors: H. Fullager, S. T. Thayer, H. Orenshire and others.

BUFFALO, N. Y.—The Grand Island Telephone Company, of Buffalo, has been formed; capital, $10,000, and directors: Josiah Jewett, Jr., F. H. Williams and J. P. Williams, of Buffalo.

ALBANY, N. Y.—The New York State Independent Telephone Association has been incorporated. Among the directors are W. D. Barnard, of Philadelphia; E. B. Barbour, of Wauseon, Ohio; and J. J. Brailey, Jr., of Toledo, Ohio.

PORT JERVIS, N. Y.—The Monticello Telephone Company has purchased of H. S. Wells, of Ellenville, the telephone lines in the village of Monticello and the lines to Kiamesha Lake and South Fallsburgh, which were formerly owned and operated by the Delaware River Telephone and Telegraph Company.

NEW YORK CITY, N. Y.—Fire Commissioner Sturgis has decided to make a separate bureau out of the fire alarm telegraph system. This system was a separate bureau until 1898, when it was put in charge of the Chief of the Fire Department. It is understood about Fire Headquarters that J. Elliott Smith, who was the incumbent of the position at the time the bureau was abolished, will again be an applicant for the position.

COLUMBUS, N. C.—The Columbus Telephone Company has closed a contract with the Bell Company to bring its line to Wilmington, where it will connect with the Bell service. The line will be completed in thirty days.

CONNEAUT, OHIO.—The Albion Telephone Company will extend its lines to Keepville and Cherry Hill.

URBANA, OHIO.—The Urbana Telephone Company has increased its capital stock from $5,000 to $10,000.

UNIONTOWN, OHIO.—The Flushing Telephone Company has several men at work putting up a line to Uniontown.

CLEVELAND, OHIO.—The village of Glenville has granted a franchise to the Cleveland Telephone Company to install its system in the town.

ROWENTON, OHIO.—A farmers' community company has been organized to build local lines throughout Rowenton, Sentinel, and Lenox Center.

COLUMBUS, OHIO.—The North Lewisburg Telephone Company, of Champaign County, was incorporated with $6,000 capital stock by W. H. Willis, L. E. Willis and others.

NORTH LEWISBURG, OHIO.—The North Lewisburg Telephone Company has been incorporated with $6,000 capital stock by W. H. Willis, L. E. Willis, N. S. Willis, M. S. Willis and L. L. Fisher.

MINISTER, OHIO.—The Minister Home Telephone Company, of Auglaize County, has been incorporated with $10,000 by L. L. Dine, F. L. Maisen, John Laupeiswiler, J. W. Eiting, M. Hosborn and others, to build a local system at Minister.

NORTH LIMA, OHIO.—Work on the lines of the Beaver Telephone Company in this section has been abandoned temporarily because of inability to secure workmen during harvests. The North Lima exchange will be built as soon as possible.

OAKWOOD, OHIO.—Citizens of Brown and Auglaize townships are planning to build a telephone line from Oakwood to Defiance by way of Schroeder, Arthur and Englewood. The exchange will be at Oakwood. Herman Schroeder and L. Reams, of Oakwood, are interested.

CINCINNATI, OHIO.—The W. F. Harrison Telephone Company of Cincinnati, which is constructing the exchange of the Texarkana Telephone Company in Texas and Arkansas, has closed contracts for the equipment. The company has subscriptions for 1,000 telephones in Texarkana alone.

LANCASTER, OHIO.—The McArthur Home Telephone Company will build a line from Bloomingville to Tarlton and New Plymouth, connecting with the long distance systems of other companies in that section. The gap between New Plymouth and Lancaster will be built in the near future.

YOUNGSTOWN, OHIO.—For some time various associations of merchants have been endeavoring to induce their members to patronize one telephone service to the exclusion of the other. The Retail Grocers' Association endorsed the Youngstown Telephone Company. Now the grocers outside of the association have notified the Central Union Company that they will use its telephone exclusively. It seems impossible for all the associations to settle on one service, hence the object of the crusade is likely to be defeated.

TUNKHANNOCK, PA.—The Tunkhannock and Wyoming Valley Telephone Company has been incorporated; capital, $2,000.

CHARLESTON, S. C.—The Bell Telephone Company has begun the work of putting its wires underground in Charleston.

WINNSBORO, S. C.—A commission has been issued to the St. Matthew's Telephone Exchange which proposes to run telephone lines in St. Matthew's and to connect with neighboring points. The corporators named are: L. M. Able, J. S. Wanamaker, H. A. Raysor, M. Jarecy and S. Pearline. The capital stock is $1,500.

AUSTIN, TEX.—The Farmers' Telephone Company of High, Lamar County has been incorporated; capital stock, $7,000. The incorporators are M. D. High, Fred Roach and D. W. Price.

DALLAS, TEX.—The Greenville Telephone Company, of Greenville, filed an amendment to its charter increasing its capital stock from $25,000 to $35,000

WHITEWRIGHT, TEX.—The Whitewright Telephone Company has been incorporated with a capital stock of $10,000. The incorporators are: W. C. Fain, R. May and Lillie Selph.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company's Salt Lake City exchange has connection now with 478 nearby towns.

KENOSHA, WIS.—An independent telephone system has been established at Kenosha.

KAUKAUNA, WIS.—The Fox River Telephone Company will extend its lines to this place.

HARTFORD, WIS.—The Wisconsin Telephone Company is extending its line from Hartford to Mayville.

THIENSVILLE, WIS.—The Mequon Telephone Company of Thiensville has been incorporated, with a capital of $2,500.

BARABOO, WIS.—The Bell Telephone Manufacturing Company, Baraboo, capital stock $20,000, has been incorporated by W. J. Whistler and W. J. Bell.

ELECTRIC LIGHT AND POWER.

LITTLE ROCK, ARK.—The Stuttgart Water and Electric Light and Power Company has filed an amendment to its articles of incorporation increasing the capital stock from $25,000 to $50,000.

SAN FRANCISCO, CALIF.—The Brandy Creek Water, Light and Power Company has been incorporated with a capital stock of $250,000. The directors are: W. A. Hall, J. M. Gardner, W. M. Sheldon, F. M. Archer and James H. Devereaux.

SAN FRANCISCO, CALIF.—The gold dredging mining plant which Dr. T. R. Heintz is constructing on Clear Creek, near Horsetown, will be lighted and operated by electricity furnished by the Northern California Power Company. The power will be tranmitted from the sub-station near Redding.

AUGUSTA, GA.—The Augusta Railway and Electric Company has signed a contract for lighting the city of Augusta for five years at the rate of $63 per light.

NEZ PERCE, IDA.—There is an opportunity to establish an electric light plant in this place.

BOISE, IDA.—The bid of the Capital City Electric Light, Motor & Gas Company to light the streets has been accepted. The company will furnish 54 450-watt arc lights at $6.50 each per month; 20 16-cp incandescent lamps at 75 cents each per month. All meter lights at 10 cents per kw.

PANA, ILL.—The lighting contract between the city and the Modern electric light plant having expired, the company has shut off the light. No new contract has been made.

CHICAGO, ILL.—The Pioneer Electric Light, Heating and Power Company has been incorporated at Marseilles; capital stock, $25,000. Incorporators: J. E. Bond, J. A. Kelso and R. F. Knott.

GRAYVILLE, ILL.—The water and light station, which was closed down some four weeks ago, has resumed operation, the company having accepted the city's offer to furnish light and water for the year.

VENICE, ILL.—The Venice Electric Light and Power Company has been transferred to George Banford, of New York. The company has been bonded for the sum of $250,000. The plant will be enlarged to three times the present capacity.

EDWARDSVILLE, ILL.—The new electric company which was recently granted a franchise to operate a power plant in Edwardsville has purchased an acre of ground and will locate its power plant on it. The company is composed of J. R. Bennett, August Loeffler and William Gaertner, of Wyandotte, Mich.

NICHOLASVILLE, KY.—The Beattie Electric Company, of Cincinnati is erecting a $11,000 electric lighting plant in Nicholasville, Ky.

BALTIMORE, MD.—The Baltimore and Ohio Railroad has been directed by the city council of Baltimore to use only electric motors in the tunnel that runs under this city.

DEXTER, MICH.—Proposals will be received until August 20 for the construction of an electric light and power plant for street and commercial lighting. Bids must be sent to A. Davis & Co., Dexter.

ST. CHARLES, MO.—The large cable of the St. Charles Light and Power Company has been laid in the river. It will carry power for the St. Charles, St. Louis and Western electric railway.

CARROLLTON, MO.—The Carrollton Water, Light and Power Company, of Carrollton, has been incorporated. The capital stock is $100,000, all paid. Incorporators: Herndon Ely, Pete L. Trotter, Lewis B. Ely, W. R. Painter and others.

ST, LOUIS, MO.—Immediately after the contract is let for the lighting of the public buildings for the year ending September, 1903, the board of public improvements will have bills prepared looking towards the installation of the city's own lighting plants in the public buildings. It is expected that during the coming year this work will progress so rapidly that all the public buildings will be lighted by the city's own plants after another contract for a year expires with private lighting companies. Then the board expects to take steps toward ultimate ownership by the city of lighting plants for the lighting of the streets.

ST. LOUIS, MO.—The Neighborhood Light, Power and Heating Company has been organized with a capital of $50,000 for the purpose of building a plant to furnish heat and electricity to buildings in the block bounded by Olive and Locust, Seventh and Eighth Streets. The new company is composed of Missouri Trust and Chemical Building stockholders. It was originally formed to supply the Union Trust and Chemical Buildings, but later arrangements were made to furnish light, power and heat to other buildings in the block. The power plant will be installed in the basement of the Union Trust Building. Contracts have been let for the boilers, and electrical machinery, and work will begin at once. President Schfley, of the Missouri Trust Company, owners of the Union Trust Building, says that all negotiations for the deal have been closed and only the signatures of the principals are needed before the incorporation papers are filed.

ST. LOUIS, MO.—An issue of $10,000,000 5 per cent. thirty-year gold bonds has been decided upon by the Union Electric Light and Power Company, recently organized for the consolidation of the Citizens' and the Imperial companies. Only $4,000,000 will be issued at once, however. This amount will be issued as soon as the details can be arranged, and all have been underwritten, one-half by St. Louisans and the other half in New York, the Mississippi Valley Trust Company, of this city, and the North American Company of New York acting as syndicate agents in the deal. The bond issue was authorized at a meeting held this week. The $4,000,000 will be used to retire the $1,552,000 underlying bonds of the Imperial company and the remainder to complete the immense plant started by the Citizens' company before the consolidation and in other improvements. The bonds have all been subscribed for, and a majority will be taken in St. Louis.

HAVRE, MONT.—An electric light franchise has been granted to eastern capitalists in Havre. A telephone franchise will be granted soon.

HELENA, MONT.—A company has been organized in Butte and Helena by Hogan Bros., called the Crooked River Electric Mining & Power Company. It intends erecting a 2000-hp electric plant on that stream as soon as the necessary machinery can be furnished. Power will be furnished the company's big quartz mine on the river as well as other mining properties in the vicinity.

HAWTHORNE, NEV.—The Consolidated Mines Company of Hawthorne will erect a large power plant using the waters of Twin River. Transmission lines will be built to the mines in the surrounding country. About $200,000 will be expended.

RALEIGH, N. C.—The city of Raleigh has contracted with the Raleigh Electric Railway Company for 155 arc lights at $55.75 each.

MANCHESTER, OHIO.—A committee of citizens is inspecting various lighting plants in this section with a view of planning a lighting plant for Manchester. S. S. Alexander, J. A. Murray and Peter Stark are interested.

CLEVELAND, OHIO.—The Cleveland Electric Illuminating Company has voluntarily returned the valuation of its personal property as $402,000. Last year the company paid taxes on a valuation of $250,000.

AKRON, OHIO.—The present lighting facilities of Barberton are inadequate and the council has accepted the invitation of the Northern Ohio Traction Company to inspect its power house with a view of arranging for a contract to illuminate the town.

DALLAS, TEX.—The plant and other property of the Dallas Electric Company was sold at United States Receivers' sale, Aug. 5, for $300,000, to representatives of the bond holders of the old Dallas Electric Light and Power Company. The purchasers are Boston capitalists, known locally as the "Bonta party." Mr. Bonta represents the Dallas electric street railway enterprises, the United Electric Securities Company of Boston, and it is understood he will direct the affairs of the Dallas Electric Company. The property is worth upwards of $1,000,000.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—It is reported that the Huntington-Hellman syndicate has decided to build an electric railway from Los Angeles to Santa Barbara, Calif. The large capacity of the new power house of the Huntington electric lines in Los Angeles would be an advantage in connection with a line to Santa Barbara. It is possible that the road will be built through Ventura.

WASHINGTON, D. C.—The Washington, Baltimore and Annapolis Electric Railway Company reports that it expects that cars will be in operation within one year. The line is now being graded between Washington and Baltimore. The company's power plant may be located at Hyattsville. This company will construct an interurban line between this city and Lima, O. Charles and Baltimore Railway, and if successful, will use the tracks of this company from Odenton to Annapolis.

MORRISTOWN, IND.—A fifty-years' franchise was granted by this city to Charles L. Henry and J. F. Wild for an electric railway to be constructed between Indianapolis and Rushville.

FT. WAYNE, IND.—The Ft. Wayne, VanWert and Lima Traction Company has filed articles of incorporation. The capital stock is $2,000,000. The company will construct an interurban line between this city and Lima, O. Charles Murdock heads the board of directors.

HUNTINGTON, IND.—The Ft. Wayne & Southwestern Traction Company, now operating a line between Andrews and Ft. Wayne, and almost ready to begin running on to Wabash, has doubled its capacity of its power-house in this city. It now has two 750-hp engines in service. The company has almost completed negotiations for a right-of-way to Warren, and from there the line will be built to Marion.

HARTFORD, KY.—The Hartford & Beaver Dam Electric Railway Company has changed its name to the Rough River Valley Railroad Company. It is expected that the road will be under construction by September 1.

AUGUSTA, ME.—The Maine and New Hampshire Railroad Company has filed articles of association here. This is to be the longest electric line in the State—ninety miles. The capitalization of the company is $400,000.

NEW YORK, N. Y.—Mayor Low has allowed to become law without his official sanction, a resolution requesting the Metropolitan Street Railway to change the motive power on First Avenue from horse to electricity.

ALBANY, N. Y.—The Richmond Street Railway Company has been incorporated with $190,000 capital. It takes the property of the Staten Island Electric Railroad. Directors: Waldo S. Reed, Englewood; William T. Newkirk, Paterson; Cornelius W. Van Voorhees, Mariners' Harbor; Frank B. Hammer, Brooklyn.

ALBANY, N. Y.—The Mineola, Roslyn and Port Washington Traction Company, of Roslyn, Nassau County, has been incorporated to build a street surface electric road ten miles long, from Mineola, in the town of North Hempstead, to Port Washington. The capital is $150,000, and the directors are Isaac H. Odell, Frederick H. Parker, Jacob Besant Gardner, P. Harrington and others of New York City.

ALBANY, N. Y.—The Vermont and Whitehall Railway Company, with principal office in New York City, has been incorporated with a capital stock of $500,000. The line lies in Washington County. The directors are: David A. Slattery, J. Osgood Nichols, K. C. Morehous, Paul M. Mowery, Leroy W. Baldwin, Harry M. Gough, Clinton E. Braine and Ronald K. Brown, of New York City, and Ezra A. Tuttle, of Brooklyn.

COLUMBUS, OHIO.—The Columbus, Delaware & Marion Railway Company will probably build a spur line from Prospect to Richwood.

CLEVELAND, OHIO.—The Cleveland, Elyria & Western Railway Company is planning to build spur lines from Oberlin to the villages of LaGrange and Kipton.

COLUMBUS, OHIO.—E. W. Matthews, formerly receiver for the Toledo & Ohio Central Railway, has taken up the long-talked-of project for an electric railway from Bryan to Columbus.

YOUNGSTOWN, OHIO.—The Mahoning Valley Western Railway Company has been incorporated with $1,000 capital stock, by J. E. McVey, A. L. Rowland, J. I. Harrington, Thomas L. Robinson and J. W. Blackburn.

XENIA, OHIO.—Surveys are being made for the new line of the Xenia-Wilmington Traction Company. Options on practically the whole of the right of way have been secured. Cleveland people are financing the road.

CINCINNATI, OHIO.—The Cincinnati & Northeastern Traction Company of Dayton has been incorporated with $15,000 capital stock by Dennis Dwyer, Albert Emanuel, Charles D. McCrea, Charles L. McCrea and B. M. Hopkins. It is proposed to construct an electric road between Cincinnati and Dayton.

YOUNGSTOWN, OHIO.—The Penhale-Devitt syndicate has incorporated the Sharon & West Middlesex Electric Company to build a line from Sharon, Pa., to West Middlesex, a distance of four miles. Capital stock, $50,000. Incorporators: M. A. Norris, R. Montgomery, A. N. Perkins, A. W. Williams and Wm. McIntyre, Jr.

CANTON, OHIO.—The Canton-New Philadelphia Railway Company has been incorporated, with $6,000 capital stock. The line will be the extension of the Canton-Akron Railway from Navarre to New Philadelphia, work on which has been started. The incorporators are Philip Saltonstall, L. E. Meyers and other officials of the Canton-Akron Company.

CLEVELAND, OHIO.—The Lake Shore Electric Railway has officially opened its through service from Cleveland to Toledo. The entire road has been in operation for several months, but no attempt has been made to work up the through business since the trip required changes at Lorain and Norwalk. The new schedule is six hours for the 118 miles, with change of cars at Norwalk. A number of cars are being equipped with high-speed motors, and as soon as these can be placed in operation, cars will run through without change and it is expected the running time will be reduced to about five hours. Already the through traffic is showing up surprisingly well.

NEW INDUSTRIAL COMPANIES.

THE TUGGLE ELECTRIC SUPPLY COMPANY, of Beaumont, Tex., has been chartered, with $25,000 capital, by G. W. Tuggle, E. L. Bacon and J. F. Keith.

THE F. B. LITTLE ELECTRIC COMPANY has been incorporated at St. Louis, with a capital stock of $3,000. The shareholders are: C. V. Wade, C. E. Campbell, F. B. Little, W. F. Little.

THE MICROPHONE TRANSMITTER COMPANY, Boston, Mass., has been organized under the laws of Maine to manufacture a telephone transmitter. The capital stock is $500,000.

THE CLIMAX ELECTRIC STORAGE BATTERY & VEHICLE COMPANY, of Portland, Me., has been incorporated; capital, $500,000; William Bowler and John Oldfield, incorporators.

THE BALL CHECK LIGHT COMPANY, of East Orange, N. J., has been incorporated to manufacture lighting devices; capital, $1,000,000. Incorporators: Edward T. Magoffin, Frank R. Searles and Walter H. Bond.

THE SUBWAY AND WESTCHESTER CONSTRUCTION COMPANY, of Mamaroneck, Westchester County, N. Y., has been incorporated at Albany with a capital of $400,000, to construct railways, etc. The directors are: George T. Foster, J. W. Edwards, Jersey City; Theodore M. Johnson, F. B. Hough, Albert Tusch, Jr., of New York City.

LEGAL.

MARCONI-DE FOREST LITIGATION.—The Marconi Wireless Telegraph Company of America, by its attorneys, Betts, Betts, Sheffield & Betts, has filed a bill of complaint in the United States Circuit Court for the Southern District of New York against the De Forest Wireless Telegraph Company for an alleged infringement of the Marconi basic patent by the De Forest system, and especially by the so-called "anti-coherer." An injunction is asked for to stop the use of the Marconi patent by the De Forest system. Also an accounting for the ascertainment and payment of damages. Knabe & Butler are counsel for the defendants.

WIRELESS TELEGRAPH LITIGATION.—Action has been begun by the De Forest Wireless Telegraph Company against the Marconi Wireless Telegraph Company and the firm of E. Rollins Morse & Brother, syndicate managers for the Marconi Company, for $1,000,000 damages for the publication of an article stating that action had been begun by the Marconi Company against the De Forest system for infringement of the Marconi patents. The attorneys for the Marconi Wireless Telegraph Company express the opinion that this suit was brought mainly for the purpose of an advertisement, as the papers were served upon the newspapers before they were made known to the defendants.

OBITUARY.

MR. W. A. SCOTT.—A special telegram from Chicago, of August 9, says: Walter A. Scott, the wealthy president of the Illinois Wire Company, was stabbed to death in his office to-day by Walter Stebbings, a well-known bridge engineer, The stabbing was witnessed only by Miss Myrtle Shumate, Scott's stenographer, who fled screaming from the Monadnock Building, in which Mr. Scott had his offices. Immediately afterward the slayer walked quietly across the hall to his own office, and was writing business letters when the police burst in on him. On being told that Scott was dead Stebbings reeled and would have fallen had he not been supported. "Dead!" he exclaimed. "I did not know I stabbed him. I thought I had merely knocked him down." The engineer was taken to jail almost in a state of collapse. Mr. Scott was reputed to be a millionaire. Until recently he was president and owner of the Marshfield and Southeastern Railroad and the Scott Lumber Company. He was heavily interested in real estate. Stebbings was favorably known among engineers as the designer of the High Bridge in Lincoln Park, and also of the Chicago, Milwaukee and St. Paul swing bridge over the river near Kinzie Street. Mr. Stebbings asserted that Scott owed him $3,000 for professional work, but payment had been refused. The engineer called at Scott's office again this morning in an effort to affect a settlement. Miss Shumate says that the two men soon quarreled violently, and a moment later were striking and kicking at each other. Then came the flash of steel, and Scott sank to the floor. She fled in panic, while Stebbings walked quietly away. It would appear that Mr. Stebbings had unconsciously picked up or used a Japanese envelope opener he had in his hand. Mr. Scott was forty-three years old. He lived at the Virginia House. A widow and one son survive him, the latter being twenty years old. The widow and son are at present out of the city on a vacation tour in the East.

PERSONAL.

PROF. F. B. CROCKER, of Columbia University, has left New York for a long holiday until the fall, in Colorado, etc.

MR. N. F. BRADY, first vice-president of the New York Edison Company, left last week on the "Celtic" for England, proposing to spend a month or two in European travel.

MR. THOMAS F. RYAN, the financier, sailed this week for Europe on board the steamship "Kaiser Wilhelm der Grosse," for a six-weeks' trip, entirely for purposes of recreation.

MR. J. K. ROBINSON, agent for the Westinghouse Electric Mfg. Company, at Iquique, Chili, has sailed this week for that city, from New York, so that all letters hereafter should be addressed to him there.

MR. E. LE C. HEGEMAN, a young New York electrical engineer, has sailed this week for Chili, to be associated with Mr. J. K. Robinson, who represents Westinghouse interests on the western coast of South America.

MR. W. E. DICKEY, past assistant engineer, U.S.N., is to represent in New York City the Goulds Mfg. Company, of Seneca Falls, and the West Point Boiler Works (R. Munroe & Sons), Pittsburg, Pa. His headquarters will be at 16 Murray Street.

MR. GEORGE W. HUTCHINS, the electrical contractor and engineer, of St. Louis, has left for East Las Vegas, New Mexico, where he is to build the Las Vegas & Hot Springs Railroad for the E. L. Epperson Construction Company of St. Louis.

MR. CHAS. F. SCOTT, chief electrician of the Westinghouse Electric & Manufacturing Company and president of the American Institute of Electrical Engineers, has just returned from England, where he has spent the last few months engaged on important professional work.

MR. GEORGE L. COLGATE, at one time well known in electrical enterprises in the South and in New York, has been spending the past few years in California for the benefit of his health. He has now returned to the East and with wonted energy is already engaged making business connections.

PROF. G. F. SEVER, of the electrical engineering department of Columbia University, has, we understand, been selected as consulting engineer for the Greater New York Department of Gas and Electricity. The position is said to carry with it a salary of $4,000 a year, and is one of the best appointments in the gift of Col. Monroe, the Commissioner.

MR. FRANK MILLER, formerly superintendent and purchasing agent of the Worcester & Webster St. Ry., Worcester, Mass., has accepted the position of salesman with the firm of C. J. Harrington, 15 Cortlandt Street, New York City, manufacturer of a full line of electric railroad and line material, and will cover for this firm the New England territory, where he has a wide and influential acquaintance.

MR. R. E. GALLAHER, the well-known general manager of the New York Insulated Wire Company, is now at the Thousand Islands, recuperating from a long and very severe attack of gastric fever. Mr. Gallaher's public spirited and intelligent work in behalf of the New York Electrical Trade Society and for the furtherance of commercial interests, has caused him to be missed throughout a wide circle of friends and admirers, all of whom will heartily welcome his return to business in the fall.

MR. T. A. EDISON.—The official organ of the Press Exhibition, which was opened at Copenhagen, Denmark, on June 14, prints a letter from Thomas A. Edison in reply to queries as to his opinions concerning motor traction, and aerial navigation. The letter is as follows: "I believe that within thirty years nearly all railways will discard steam locomotives and adopt electric motors, and that the electric automobile will displace the horse almost entirely. In the present state of science, there are no known facts by which one could predict any commercial future for aerial navigation."

Trade Notes.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is sending out booklets describing the push-button telephone, the latest thing in the telephone line. It looks like a push button, acts like one when desired and is a complete telephone as well.

ALTERNATING CURRENT BELL.—The Wotton Electric and Manufacturing Company, Atlanta, Ga., has just designed an alternating current bell which can be operated successfully on a 60-cycle circuit. The bell, which is similar to this company's telephone extension bell, is said to work very satisfactorily.

U. S. METAL POLISH.—Mr. George W. Hoffman, manufacturer of "U. S. Infallible Metal Polish Paste," reports that his business is steadily increasing, and that he is shipping "U. S. Metal Polish and Barkeepers' Friend" all over the world. This fact proves that the world appreciates a good thing when proper attention is directed to it.

INCANDESCENT ELECTRIC LIGHT.—The Sawyer-Man Electric Company, New York, has recently published a very interesting and artistically illustrated pamphlet under the title "Incandescent Electric Light." Its contents are classified under three general heads, viz.: Historical sketch; How the Sawyer-Man lamp is made, and suggestions for those who use incandescent lamps. The historical sketch briefly reviews the development of the electric lamp from Davy's time down to the present, and is very liberally illustrated. The description of the making of Sawyer-Man lamps is an interesting study, and the suggestions offered to users of incandescent lamps are calculated to enable the consumer to get the best results.

STATIONARY ENGINEERS.—The local associations at Chicago of the National Association of Stationary Engineers have made arrangements with the Dearborn Drug & Chemical Works to use their offices and laboratories, situated on the first floor of the Rialto Building, 145 Van Buren Street, as headquarters for the delegates and visitors going through Chicago on their way to the convention at Boston, on Saturday and Sunday, August 30 and 31. The offices will be open at 6 o'clock Sunday morning and remain open until train time. Refreshments will be served, and arrangements have been made to take care of the ladies, and they will be taken to the depot in carriages. Delegates and visitors will take their grips and baggage direct to these headquarters.

THE NERNST LAMP COMPANY has placed upon the market a special lamp designed particularly for the illumination of telephone switchboards. This lamp has already been adopted in several stations and is reported to give a much more satisfactory illumination on the switchboard and at the same time offers complete protection to the eyes of the attendant. One Nernst lamp does the duty formerly required of three incandescents. The Nernst lamp is found to be particularly well adapted for the illumination of boards using the lamp signal system on account of the soft white light emitted, enabling the operator to readily distinguish the switchboard lamps when lighted. Other forms of illumination for this purpose have not been found entirely satisfactory because of the yellow quality of the light.

LINK-BELT ENGINEERING COMPANY.—One of the handsomest trade catalogues which has recently fallen into our hands is that issued by the Link-Belt Engineering Company, of Nicetown, Philadelphia, Pa., on the subject of modern methods applied to elevating and conveying of materials and the transmission of power. This catalogue is issued in a standard size—6 ins. by 9 ins.—and is strongly bound in boards and green cloth. It contains no fewer than 320 pages and summarizes or epitomizes the art of which it treats. In addition to a large amount of engineering matter, various tables, compilations of data, etc., the catalogue includes a large number of cuts, many of which are full-page and illustrate practical installations of the various conveying systems with which the name of "Link-Belt" has been so long and so successfully connected. The ingenuity of the processes and the skilful manner in which human labor and manipulation has been eliminated from the transportation of even very heavy material, must win hearty admiration. The processes involved are essentially those which have ensured the universal adoption of American methods in the conveyance of material, loose or in packages, and the catalogue as it stands is virtually an exhaustive treatise on this branch of industrial art. The amount of work done with the Dodge coal storage system as here enumerated, is simply stupendous, but we imagine that if the figures were given of the different bulks of material also transported by the company's conveying systems in other lines of work, other and larger millions of tonnage would appear from the calculation. Aside from the conveying apparatus as such, a number of devices are included appropriate to power transmission, all marked by the same high standard of ingenuity and perfect application to the work in hand.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUGUST 5, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

706,011. ART OF CONTROLLING ELECTRICAL SWITCHES OPERATED BY ELECTRO-MAGNETS; F. Bourne, Mount Vernon, N. Y. App. filed Nov. 8, 1901. Consisting in controlling the movements of the circuit by two magnetic forces in such manner that when the circuit is first closed, they act conjointly and afterward oppose each other.

706,012. ELECTRO-MAGNETIC SWITCH; F. Bourne, Mount Vernon, N. Y. App. filed Nov. 8, 1901. Apparatus for carrying out the previously described method.

706,017. DYNAMO ELECTRIC MACHINE; J. Burke, Berlin, Germany. App. filed June 26, 1900. (See Current News and Notes.)

706,020. TRAIN CONTROL SYSTEM; F. E. Case, Schenectady, N. Y. App filed Jan. 7, 1901. Means for preventing the further operation of the master controller in case any of the sub-controllers fail to operate.

706,039. ELECTRIC REGULATOR; A. R. Everest, Lynn, Mass. App. filed Oct. 9, 1900. A potential regulator having a row of fixed contacts, a movable contact co-operating therewith and a change-over switch brought into operation as the movable contact passes from one fixed contact to another and co-operating with the movable contact to reverse the connection of the row of fixed contacts with respect to the circuit to be regulated.

706,053. MEANS AND APPLIANCES FOR THE MANUFACTURE OF COVERED STRIPS OF SOFT METAL FOR ELECTRICAL OR OTHER PURPOSES; I. W. Heysinger, Philadelphia, Pa. App. filed Dec. 4, 1901. Flat strips of soft metal are first covered with cement, then with a braided textile cover and then stitched through with rows of stitching so located that the strip can be cut up into narrow strips and used for conductors.

706,055. TIME LIMIT CIRCUIT-BREAKER; H. M. Hobart, Berlin, Germany, App. filed Jan. 5, 1901. (See Current News and Notes.)

706,062. MAGAZINE FUSE BOX; H. L. Hunt and W. E. Moon, Traverse City, Mich. App. filed Nov. 5, 1901. Details.

706,076. FLEXIBLE CONDUIT OR TUBE; G. A. Lutz, Brooklyn, N. Y. App. filed Nov. 20, 1901. The tube is formed by winding a continuous concave strip spirally and laying the spirals one over the other in such manner as to prevent the lengthening of the tube while permitting flexure.

706,082. AUTOMATIC POLE REVERSER; M. Moskowitz, Brooklyn, N. Y. App. filed Aug. 27, 1902. A pole changer controlled by the resulting motion due to the opposition of a spring and a centrifugal force.

706,083. AUTOMATIC SWITCH; M. Moskowitz, Brooklyn, N. Y. App. filed Sept. 28, 1901. Details.

706,084. AUTOMATIC SWITCH; M. Moskowitz, Brooklyn, N. Y. App. filed Sept. 28, 1901. A claim describes the invention as follows: In combination with an electrical switch and as a means for actuating the switch when the direction of rotation of a rotary body reverses, a rotary part suitably mounted and subject to such reversals of rotation, and a retractable engaging device movably mounted upon the said rotary part for engaging and actuating the switch in either direction, the said retractable-engaging device being provided with a weight for centrifugally retracting it.

706,085. ELECTRICAL SYSTEM FOR LIGHTING AND POWER; M. Moskowitz, Brooklyn, N. Y. App. filed Sept. 28, 1901. This invention contemplates the use of a motor-dynamo, the motor portion of which is driven from the main generator and the dynamo of which excites the field magnet of the generator when the proper conditions have been obtained.

706,092. TROLLEY POLE CATCH; J. A. Norton, Wilkesbarre, Pa. App. filed Nov. 19, 1901. A lock intended to catch the trolley pole when it is thrown violently downward.

706,099. ELECTRIC FURNACE; A. Parker, Chorley, Eng. App. filed May 8, 1901. (See page 258.)

706,106. ELECTRIC RAILWAY; W. B. Potter, Schenectady, N. Y. App. filed Nov. 18, 1896. A third rail system in which the continuity of the third rail is interrupted at stations or crossings and sectional conductors substituted therefor, which are normally disconnected from the source of supply.

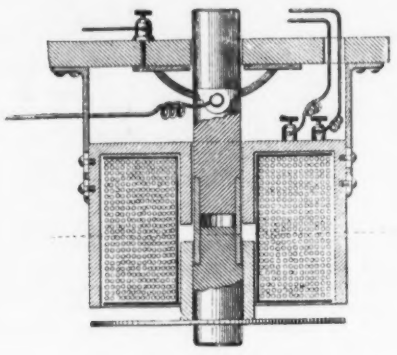
706,108. DYNAMO ELECTRIC MACHINE; H. G. Riest, Schenectady, N. Y. App. filed Nov. 13, 1900. (See Current News and Notes.)

706,123. SYSTEM OF ELECTRICAL DISTRIBUTION; C. P. Steinmetz, Schenectady, N. Y. App. filed June 30, 1900. In constant current arc lighting through rectifiers, makes use of one large source of current for all the rectifiers or at least any given group, and feeds each individual rectifier from the secondary of a transformer, the primary of which is in series with the primary windings of the companion transformers and in circuit with the source of constant current.

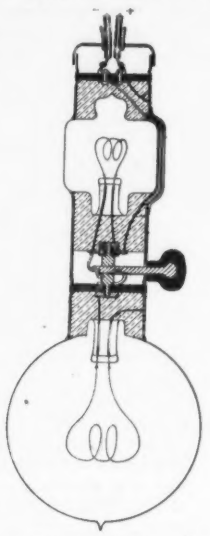
706,126. ELECTRIC CONTROLLING APPARATUS FOR ELEVATORS; A. Sundh, Yonkers, N. Y. App. filed Jan. 31, 1902. The controlling circuit is of lower potential than the main circuit, but is derived from a shunt to the main.

706,128. ELECTRIC FURNACE; E. R. Taylor, Penn Yan, N. Y. App. filed April 4, 1901. Renewed Jan. 2, 1902. (See page 258.)

706,143. MEANS FOR CONTROLLING ELECTRIC CIRCUITS; J. J. Wood, Fort Wayne, Ind. App. filed June 28, 1901. Improved means for controlling the several line circuits from a central power station, and restoring the current to several lines one by one in succession, and avoiding overload of generators due to the effort of motorman to start up all the cars again at once.



706,012.—Electromagnetic Switch.



706,314.—Compound Incandescent Electric Lamp.

706,146. MECHANISM FOR RECORDING OR REGISTERING THE MAXIMUM MOVEMENT OF ANY MECHANISM; L. B. Atkinson, London, Eng. App. filed May 12, 1902. A ball is caused to shift its position when the index reaches a position of maximum indication.

706,156. ELECTRIC RAILWAY; C. R. Campbell, New York, N. Y. App. filed Dec. 28, 1900. Details of a third-rail system.

706,165. SYSTEM OF ELECTRICAL DISTRIBUTION FOR CAR LIGHTING PURPOSES; J. L. Creveling, New York, N. Y. App. filed Dec. 7, 1900. The magnetization of the generator is controlled by two electromagnetic devices, one being in the work-circuit and adapted under predetermined conditions to act upon the other and thereby regulate the generator.

706,169. ANTISEPTIC TELEPHONE MOUTHPIECE; W. M. English and G. A. Burns, San Francisco, Calif. App. filed Oct. 28, 1901. (See page 256.)

706,177. MEANS FOR TESTING THERMOSTATS; T. M. Heaphy, London, Eng. App. filed Aug. 8, 1900. (See Current News and Notes.)

706,194. INSULATOR; L. McCarthy, Boston, Mass. App. filed May 26, 1902. Two terminal pieces linked together by a block of wood and the joint encased in a mass of insulating material.

706,211. TROLLEY WHEEL; R. H. Apelt, Boston, Mass. App. filed March 30, 1901. Details.

706,218. ELECTRIC SIGNALING SYSTEM AND APPARATUS USED THEREIN; R. G. Callum, Washington, D. C. App. filed Jan. 9, 1902. Consists in connecting the point to be signaled from, with the central station by a normally closed metallic circuit having a ground connection at the central station dividing the batteries so that a portion will be on each side of the connection; means are then provided for grounding the circuit at the signaling point and transmitting signals at both sides of the ground connection.

706,219. METHOD OF OPERATING ELECTRIC RAILWAYS; C. R. Campbell, New York, N. Y. App. filed May 6, 1902. A method of operating third-rail systems.

706,226. ELECTRIC TRAIN CONNECTOR; C. E. Felt and D. C. Kimbark, Chicago, Ill. App. filed Nov. 29, 1901. Details.

706,251. MECHANICAL TELEGRAPH TRANSMITTER; J. W. McDonald, Larimore, N. D. App. filed Jan. 27, 1902. Morse characters are indicated on the rims of wheels, any one of which can be rotated to send its character to line by depressing a key which mechanically connects the disk with a rotating shaft.

706,260. PRESSURE REGULATOR; J. L. Schureman, Chicago, Ill. App. filed May 31, 1902. An adjusting mechanism is interposed in the lever connection between a diaphragm and a circuit breaker for regulating the effect of the diaphragm's movements upon the circuit breaker.

706,281. MEANS FOR TRANSMITTING MOVEMENTS AND INDICATING POSITIONS ELECTRICALLY; W. A. Thiermann, Hanover, Germany. App. filed Nov. 12, 1901. The apparatus consists of a rotor and a stator. The rotors are bipolar and have no winding; the stators have a sectional winding, the sections of which are connected in parallel. The stators also have a second winding connected with a source of electricity which acts as the primary coil of a transformer, while the other winding acts as the secondary.

706,283. ELECTRIC GLASS FURNACE; A. Voelker, Cologne, Germany. App. filed April 25, 1901. (See page 258.)

706,286. BRUSH HOLDER; F. T. Weidaw, Syracuse, N. Y. App. filed Feb. 10, 1902. The brush clamp is secured to the central portion of a bow-spring whose opposite ends are secured to the brush holder support.

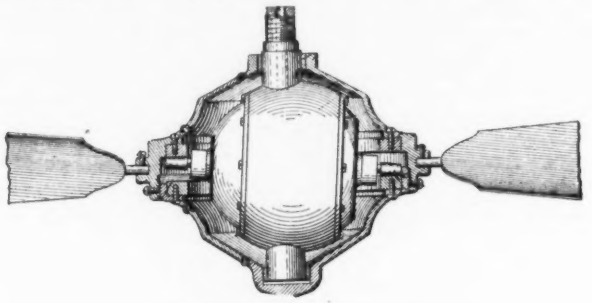
706,295. STARTING MECHANISM FOR TRAINS; J. B. Blood, Newburyport, Mass. App. filed Aug. 28, 1901. A train signaling device consisting of pressure controllers on each car and means whereby the starting signal is consequent upon the coincident condition of all of the pressure devices.

706,308. TELEPHONE CIRCUIT; I. H. Farnham, Dec'd, Wellesley, Mass. App. filed July 2, 1901. (See page 256.)

706,313. INCANDESCENT ELECTRIC LAMP; H. Gilmore, Boston, Mass. App. filed April 7, 1900. An improved connector between the filament and leading-in wire.

706,314. COMPOUND INCANDESCENT ELECTRIC LAMP; H. Gilmore, Boston, Mass. App. filed Feb. 7, 1901. Two incandescent lamps, one with a fine filament and the other with a coarser filament and means for passing the current through the lamp with the coarser filament to bring that lamp alone to full glow, and means for passing the current through both lamps in series to so reduce the amperage that only the lamp with the fine filament will be brought to full glow.

706,317. ELECTRIC MOTOR; A. B. Holson, Chicago, Ill. App. filed Nov. 4, 1901. A ceiling fan-motor in which a pinion on each end of the armature shaft engages with facing annular gears, respectively connected to a rotating frame carrying the blades.



706,317.—Electric Motor.

706,318. COMPOSITE ELECTRIC CIRCUIT; M. H. Howell, Melrose, Mass. App. filed June 24, 1901. (See page 256.)

706,319. TELEPHONE CIRCUIT; M. H. Howell, Melrose, Mass. App. filed June 19, 1901. (See page 256.)

706,338. TROLLEY WIRE FINDER; L. C. Nolan, St. Paul, Minn. App. filed April 11, 1902. A pivoted fork arranged to be thrown above the wheel.

706,340. BATTERY; W. L. Panikoff, New Haven, Conn. App. filed March 18, 1902. A medical battery outfit wherein the battery jars are lifted to carry the elements thereinto.

706,361. INSTRUMENT FOR MEASURING ELECTRIC CURRENTS; W. Thomson, Glasgow, Scotland. App. filed Dec. 30, 1897. Improvement in measuring instruments, in which a soft iron rod or wire is drawn into a solenoid carrying the current; the plunger being hung by a ligament from a segment or circular arc fixed to the beam of a balance in such a way that said ligament passes tangentially downward and plunger moves in a straight line of its own length.

706,384. FIRE ALARM TELEGRAPH SYSTEM; R. G. Callum, Washington, D. C. App. filed Oct. 5, 1899. Renewed Jan. 11, 1902. Improvements in thermostat alarm systems, so that a renewed and more than one alarm can be sent in from the danger point; one circuit being normally open, and one closed.

706,406. CURRENT METER; G. L. Gowland, Peterboro, Can. App. filed March 22, 1902.

706,435. CIRCUIT CLOSER; D. F. Mulkey, Soddy, Tenn. App. filed Dec. 31, 1901. Details.

706,436. APPARATUS FOR THE ELECTROLYTICAL TREATMENT OF ORES OR SLIMES; F. T. Mumford, Kalgoorlie, Western Australia, Australia. App. filed Sept. 30, 1901. (See page 258.)

706,444. COMPOSITION FOR USE IN SECONDARY BATTERIES; C. T. J. Oppermann, London, Eng. App. filed Jan. 11, 1902. Active material consisting of lead oxid in a solution containing bitumen intended to render the active material harder and more coherent.

706,478. FLUID PRESSURE ELECTRIC SWITCH CONTROLLING APPARATUS; A. Sundh, Yonkers, N. Y. App. filed Dec. 16, 1901. A quick acting power switch.

706,500. WIRELESS TELEGRAPHY; H. Shoemaker, Philadelphia, Pa. App. filed Oct. 25, 1901. Employs a receiver built up of a plurality of plates in inductive relation; means for permanently charging the plates, and a local circuit controlled by said plates.